MENTAL DISCIPLINE AND EDUCATIONAL VALUES

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TO MY MOTHER

PREFACE TO SECOND EDITION

The early sale of the first edition enables us to add a number of quotations from recent discussions and from recent reports of experiments. We have also enlarged our previous representation of earlier discussions and experiments, and have added a table of contents, a bibliography and index, and the dates of publication of all our references. The references and consequently the bibliography have been almost entirely confined to material bearing on the problem of mental discipline, so that the student will not be confused by references to extraneous material. Our own discussion is left for the most part as it was in the first edition, except the chapter on "Localization of Function," which has been modified and reduced.

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CHAPTER I

THE PROBLEM

It is time that recent modifications of the honored doctrine of formal discipline should have more effect on our practice. Though a great many teachers still believe in the old theory, whether or not they have carefully thought out their belief, the American students of educational psychology have been approaching a new point of view. They are reaching an agreement upon the inadequacy of "the doctrine of the applicability of mental power, however gained, to any department of human activity," or "the gymnastic theory of education that it does not matter upon what the mind is exercised, provided only the exercise be vigorous and long-continued." (De Garmo.)[1] Most of the recent American

[1] De Garmo, *Dictionary of Philosophy and Psychology*, 1901-2, "Formal Culture."

and a few of the recent foreign books on education suggest some modification of the doctrine of formal discipline, but the discussion of the subject is still in the polemical stage.

General destructive criticism is not sufficient. We must come to realize in what specific ways the doctrine of formal discipline is false and in what specific ways it affects unfavorably present aims, curricula, and methods. But even then our position would still be negative and therefore, at best, only a means to some positive conclusion. We must also establish a standard for the disciplinary value of studies and then apply that standard to the different elements in the curriculum. If we do not, we have accomplished little. Why and in what ways should a pupil get mental discipline from this or that study? To show why and in what way he does *not* get it is valuable only as a process of elimination in working toward a positive diagnosis. But even then, we have a third problem, the practical modification of courses and methods so as to gain from each and every part of each and every study its real, not to strive for its imagined, disciplinary value. These three large problems are discouraging when seen together in their significance. The practical changes involved are so far-reaching

and the need for them so difficult to prove definitely that both profession and laity are skeptical. In contrast to these difficulties, the doctrine of formal discipline has the momentum of tradition, it is emphasized by influential authorities, it has a powerful hold upon many teachers, it is easy to understand in its superficial meaning, it seems to explain many evident results of education, and it has long been the cause and the defence of dominant phases of curricula and methods. One should not be surprised, therefore, that the doctrine continues to make itself felt throughout our school system and that the opposition to it is disorganized, timid, and bookish.

Can educators afford to allow this opposition to remain unproductive? If the doctrine of formal discipline were of little influence in present practice, they might content themselves with theoretical objections, but the prominence of the doctrine necessitates definite, practical suggestions and attempts to modify it. If mental discipline *is* specific, not general, there is a pressing need to recognize the fact and to reorganize school courses and methods. Popular and professional misunderstanding will yield in time to a clear presentation of the value of a course based upon a theory of specific disciplines, of specialized

habits, rather than a theory of general discipline, of generalized habits.[1] The time is ripe for working out and testing the actual disciplinary value of the subjects and parts of subjects in the school course. The experiments so far made are suggestive, though not conclusive, in regard to the changes needed, and they point the way for further theory and practice.

Testing theory and practice in order to prove the comparative disciplinary value of the elements in the curriculum is very difficult, due to the number and subtlety of the factors involved; yet no one can gainsay the truth that studies ought to prove their worth before they are accredited with an undisputed place in the curriculum. If educators can work out no proof of the comparative disciplinary value of studies, they are doomed to wander in the dark, with no clear ideas to guide them in planning courses and methods intelligently.

This book is but a tentative effort to modify the doctrine of formal discipline and, upon such a modification, to establish a standard of educa-

[1] As a good illustration of how the doctrine of specific disciplines has affected recent books on special methods, reference is made to Huey, *Psychology and Pedagogy of Reading*, 1908, pp. 363-5. The mental discipline emphasized by Huey, though far-reaching in its effects, is kept within the limits of reading, the special activity by which it is to be developed, or is applied to similar activities.

tional values. There has been no attempt to make a full discussion of the subject but merely an outline for further study, a syllabus for individual or class use. The problems of mental discipline are too unsettled at present for any one to be dogmatic or to attempt more than brief suggestions. Our secondary purpose has been to sum up and organize the discussions and experiments in regard to the disciplinary value of studies, in hope that our readers will get a first-hand idea of how far students of education have advanced in their thought on this subject. It is also hoped that the numerous quotations will save them the time and trouble of searching through the widely scattered material from which our summary has been made. Most of these quotations are grouped together in four parts of the book, and we trust that their value and interest will atone for our giving them so much space. In class discussions of the doctrine of formal discipline, we have felt the need of such a symposium of opinions to put in the hands of students as a source-book for parallel reading.

CHAPTER II

REVIEW OF DISCUSSIONS

The doctrine of formal discipline was implied in the educational practices of the Greeks and the Romans, gymnastics, music, and oratory being used to furnish a general physical and mental discipline applicable to all the needs of individual and civic life. The doctrine was at the basis of the ascetic discipline of the mediæval monastics, who sought a complete development of the soul at the expense of bodily desires. It dominated the ideals and methods of scholastic education, with the drill upon the trivium and quadrivium culminating in the barren formalism and logical subtleties of University disputations, the ideal example in the Middle Ages of general reasoning power. But the doctrine was first clearly formulated as an educational theory in the seventeenth century, especially by Locke. Though it served as a defence of mathematics, its special purpose was to uphold the classical studies, when their intrinsic value had been greatly reduced by the use

of the national vernaculars in literature, government, and education, and when the current emphasis upon them had been criticized by the growing spirit of realism in educational thought. Monroe gives an interesting account of this movement and of its influence in the next two centuries, especially upon the English secondary school and the German gymnasium.

"By the seventeenth century the linguistic and literary curriculum had become traditional, with the authority of the learning of two centuries behind it and with a scholastic procedure which in details of method and of curriculum, in the entire technique of the schoolroom, had never been equaled by any previous system of educational practice. . . . . Since this narrow humanistic education no longer had any direct connection with the practical demands of the times and no longer offered the sole approach to a knowledge of human achievement and thought, a new theory must be found to justify its perpetuation. This new theory was, in a word, that the important thing in education was not the thing learned, but the process of learning. In respect to this principle, the new education was but a revival of the formalism of mediæval scholasticism."

"The mind as a bundle of faculties was to be

developed by exercising these various powers upon appropriate tasks whose value consisted in the difficulties they offered. These faculties were considered to have no necessary connection with one another, hence these disciplines were separate and distinct things; though some faculties were higher than others. The highest was the reasoning power to be developed by appropriate discipline in mathematics, logical disputations, and the languages; but the faculty upon which all the others depended, and upon the successful development of which depended the success of the education, was the memory. Discipline of the memory then took precedence above all other exercises. The best training for the memory was afforded by the mastery of material which had no inherent interest for the child."[1]

In a similar way Graves [2] discusses Locke's formulation of the doctrine of formal discipline and its subsequent influence upon education. "This doctrine of the formal discipline has had a tremendous effect upon each stage of education in practically every country and during every period almost up to the last decade, when a decided reac-

[1] Monroe, *Text-Book in the History of Education,* 1905, pp. 505, 506, 567, 568.

[2] Graves, *History of Education,* Vol. II., 1910, pp. 306-311. See also Vol. I., 1909, pp. 196, 213.

tion began. The formal classicism of the English grammar and public schools and universities, and of the German *Gymnasien,* afford excellent examples of the influence of formal discipline. While in the United States a newer and more flexible society has enabled changes to be more readily made, but a quarter of a century ago Greek, Latin and mathematics made up most of the course in high-schools, colleges, and universities, and until very recently the effete portion of arithmetic and the husks of formal grammar were defended in our elementary education upon the score of 'formal discipline.' But, with the growth of science, the abandonment of the 'faculty' psychology, and the development of educational theory, the curriculum has everywhere been broadened, and the content of studies rather than the process of acquisition has come to be emphasized."

The first definite rejection of the doctrine of formal discipline was that by Herbart in the first quarter of the nineteenth century. This counter-influence is thus described by Henderson:—

"According to Herbart we have, not the mind and its ideas, but rather just the ideas. The ideas do the thinking. The interplay of thoughts upon each other is the activity of consciousness. Hence, there are no faculties left. Herbart saves the ter-

minology that refers to them, but with the caution that it is intended to indicate various phases of the interaction of ideas upon each other, and not in any sense separate powers of a mind to the energies of which this interaction is supposed to be due. With the faculty theory departs the notion of formal discipline, which has no place in the pedagogy of Herbart, or in that of his disciples. For them the fundamental educational conception is not discipline but apperception. The important thing for a teacher to know is, not how well drilled a child is, how well his faculties may be expected to work, but what experience he has assimilated. This exploited, it can easily be seen what material the child will be interested in, understand, and assimilate. Mental power is a function of the organized experience of the individual. Organization is inherent in the material itself, and not a result of its manipulation by a mind, or of the imposition upon it of *a priori* forms. Since form is dependent upon content, all studies are really content studies, and it is idle to talk of the disciplinary value that their form possesses independently of their subject matter." [1]

The direct influence of Herbart is shown by

[1] Henderson, *Text-Book in the Principles of Education*, 1910, Chap. X, "The Question of Formal Discipline," pp. 291, 292.

the following quotations from his followers. The German Herbartian, Rein, thus disposes of the doctrine of formal discipline: "The fiction of 'formal education' must be given up. In general, there is no such education at all; there exist simply as many kinds of formal education as there are essentially different spheres of intellectual employment." [1] The English Herbartian, Adams, has a delightful chapter on "Formal Education," satirizing the emphasis upon form regardless of content by showing the superiority from this point of view of Fagin's school of crime in "Oliver Twist." "In short, the soul is not a mere knife that may be sharpened on any whetstone, and when sharpened may be applied to any purpose—to cut cheese or to excise a cancer. The knife takes character from the whetstone." "Since we cannot have the knowing ego by itself, and since each new fact is acted upon by the facts which then form part of the apperceiving soul, it follows that the more facts that have been organized into faculty, the more readily will the mind act, and the greater will be the range of facts upon which it will act easily. There are here two different qualities—readiness and range. The former is acquired by practice in apperceiving the

[1] Rein, *Outlines of Pedagogics*, 1892, p. 61.

same or closely allied facts; the latter by apperceiving a large number of facts of different character." [1] Here we have an over-emphasis upon apperception. This chapter is applied by Hayward to the problems of instruction in moral training. "Power and skill and the other qualities desired by the advocates of formal training depend on apperception masses, and are limited by them." "Habits do not seem, to any important extent, to become generalized; the generalizing factors in conduct—though our author does not expressly say this—are not habits, but ideas." [2]

Space should be given here to the following quotation from an early reply to the Herbartians by Hugh, who upholds the doctrine of formal discipline, though recognizing "that the disciplinary value of studies should be sought, as far as possible, in those that have a value on account of their content."

"It seems, then, that formal education is to some extent a reality, according to the teachings of physiological psychology, both in the permanence of the acquisition derived from studies apart from their knowledge value, and also in the general application of this increased power for

[1] Adams, *Herbartian Psychology Applied to Education*, 1897, pp. 126, 131.

[2] Hayward, *Education and the Heredity Spectre*, 1908, p. 107.

other forms of mental activity. Intellectual training stands on very much the same basis as physical training. A man's physical nature can be trained by doing useful work or the exercises of the gymnasium, which have no value whatever except their effect upon the physical system of the performer. So one's brain system can be trained in studies that have a knowledge value for the individual, but also in those that have none. In both cases, of course, it is best that the gymnastics should be secured in the performance of useful work, as in this case two ends are gained at the same time; but as, perhaps, all kinds of work only partially develop one's physical powers, so that it is necessary to have recourse to gymnastics to complete the physical training, in the same way it may be necessary to have special exercise to develop particular brain functions, though such exercises have no knowledge value in themselves. In fact, it may be found that many physical exercises, that usually are not classed as mental training, have no less value for the training of the mind than the study of the classics or the sciences, that manual labor, foot-ball, and other forms of athletics are just as potent factors in intellectual development as many subjects of the curriculum; as they not only train the muscular system, but

also the brain cells by which the muscles are controlled." [1]

Although the doctrine of formal discipline was based on the "faculty" psychology and although its dominance was doomed when the latter was refuted, it continued dominant long after its basis was destroyed, the close connection between the two was generally overlooked, and even now many people hold to the doctrine, who would resent an intimation that they were also holding to the "faculty" psychology.

During the third quarter of the nineteenth century the doctrine of formal discipline was vigorously used and its validity was impaired in the conflict between the classics and mathematics on one side and the natural and social sciences on the other. Spencer and Huxley were the great protagonists for the sciences in this conflict. In 1867 there was published in this country a collection of essays by prominent scientists on the "Claims of Scientific Education." These essays illustrate stages in the evolution of thought from the traditional doctrine of formal discipline to the present doctrine of specific disciplines. The main argument for the disciplinary value of the sciences

[1] Hugh, *Pedagogical Seminary*, April, 1898, "Formal Education from the Standpoint of Physiological Psychology," p. 604.

is based on both the superior formal discipline and the superior specific disciplines and knowledge to be derived from them. The authors vary in their emphasis upon the former or upon the latter superiorities, but in general they emphasize a combination of both. This combination is well stated in the following extract from Youmans' introductory chapter on "Mental Discipline in Education":

"Let it be remembered that this culture does not deny the importance of mental discipline, but only the wasteful policy of vicarious discipline. The question has three aspects. The ancients employed the useless fact A for disciplinary purposes, and ignored the useful fact B. The adherents of the current theory propose to learn first the useless fact A to get the discipline necessary to acquire the useful fact B; while a rational system ignores useless A and attacks B at once, making it serve both for knowledge and discipline. The ancient view was more reasonable than that which has grown out of it. It wanted one acquisition, and it made it; the prevailing method wants one, and makes two; and as it costs as much effort to learn a useless fact as a useful one, by this method half the power is wasted." [1]

[1] Youmans, *Culture Demanded by Modern Life*, 1867, "Mental Discipline in Education," p. 23.

A further advance is represented by the following quotations from Bain, written in 1878:

"Most definitions of training are obscured through the mode of describing mind by faculties. We have seen that to train 'Memory' is a very vague way of speaking. Equally vague is it to talk of training Reason, Conception, Imagination, and so forth. Moral training is much more intelligible; there is here a habit of suppressing certain active tendencies of the mind, and fostering others; and this is done by a special discipline —like training horses or making soldiers." "The element of Form, Method, Order, Organization, as contrasted with the subject-matter viewed without reference to form, has a value of its own; and any material that displays it to advantage, and enables it to be acquired, is justified by that circumstance alone. The targets used in learning to shoot, the wooden soldiers that are aimed at in the sabre drill, although unreal, are effectual." "It depends partly on the teacher and partly on the scholar whether the element of method shall stand forth and extend itself, or whether the subjects shall only yield their own quantum of matter or information." [1]

The first definite discussion of the specific char-

[1] Bain, *Education as a Science*, 1878, pp. 139-141.

acter of formal training, which we have been able to find, was a short paper read by Hoose before the National Educational Association in 1890. This paper has been entirely overlooked, but the following extracts will show its importance: "Form in mental activity means that peculiar activity which the mind exerts when it does any particular thing, or thinks any particular thought or word." "Form is given to mental activity by the form of the subject-matter that is cognized, seized, known, thought, or done; this proposition is true in the most general sense. Each and every form of the thing to be done or thought requires its own (peculiar) form of mental activity to do it or to think it." "Exercise and repetition in the activities of one faculty lead to mastery in those particular forms only." "Mastery of one subject stands for itself alone in so far as the subject differs from others in form." "When the forms of different subjects are similar, the habit acquired upon one of the subjects will be conserved in greater or less part to aid one in learning the other subjects." "The teacher gives form in the school-room to all the subjects that are not natural —*i.e.*, to nearly all that the child studies. As the forms of the subject condition the forms of mental activity, the teacher (author) has great

power and responsibility in the school-room." [1]

Students are indebted to Ruediger [2] for calling their attention to a valuable discussion of the problem of mental discipline by Brown (E. E.) in 1893. Brown's discussion was called forth by the arguments of Ziller, the prominent Herbartian, against the claims of the formal disciplinists. "Starting from his general principle that the thought circle in which the power is first generated must be brought into close connection with that into which such power is to be carried and applied, Ziller proceeds to lay down three particular conditions on which the possibility of such carrying over of power necessarily depends. These conditions he describes as follows:

"'1. Thoughts, feelings, and other mental products which have been cultivated in one department are extended to another and assure to it their aid when both departments are brought into so close connection that the culture of the first is actually reproduced at those points and in those members where the connection is established; and not until then is such aid assured. To be sure, the culture must not only reach over from the first department into the second; the connection of the second de-

[1] Hoose, *Report of the National Educational Association,* 1890, "Mental Effects of Form in Subject-Matter," pp. 754, 755.

[2] Ruediger, *Principles of Education,* 1909, pp. 97-9.

partment with the first must be accomplished quite independently.

" '2. But a second condition must have preceded that already mentioned, if formal culture is to be certainly attained; the material in question must have been wrought out ideally.

" '3. But even when this logical elaboration of material is secured in one department and likewise the connection of the first department with the second, in one direction as well as in the opposite, the formal effect is secured, thirdly, only on condition that the material on which it is to be realized is sufficiently well known in its full extent.'

"Ziller sums up these three conditions in the following statement: 'Formal power and efficiency nowhere arises from an isolated concept-mass; it never arises unless at least the concept-mass has been logically wrought out, and even then it does not arise unless the content of that sphere in which the logically wrought-out material is to be reproduced and made good, is sufficiently well known.'

"Ziller's enumeration of three ways in which the knowledge gained in one department becomes power for other departments, is highly suggestive and valuable. But is Ziller right in asserting so absolutely that there is nothing more? Does labor and attainment in any one sphere leave be-

hind it no residuum of power available in other spheres? Is mental power wholly specific; never and in no aspect generic?"

Then follows Brown's criticism of the Herbartian exclusive emphasis upon knowledge as the basis of mental life. Brown opposes this with an equal emphasis upon the significance of will:

"If rudimentary knowledge and rudimentary will are both fundamental facts of mental action, and the one the necessary complement of the other, it would seem as if we might look for formal culture along the line of will as well as along the line of knowledge. Will finds its bearing on the purely intellectual processes in the form of voluntary attention. Another result, then, of thorough instruction in any one field of knowledge, which may be carried over into other fields and find fruitful application there, is increased power of voluntary attention. And this result answers to common experience. For men unfamiliar with psychological terms will say that sound education increases one's power of concentration, which is the same thing expressed in a different way. Furthermore, the most of the general results supposed to flow from education appear on careful analysis to be at bottom simply this. The exercise of one kind of memory may in fact increase the ability to remem-

ber anything, if it adds to the strength of voluntary attention.

"Another element of formal culture may be added to Ziller's list; though in last analysis it may not be essentially different from that already presented. Sound education in any one department of knowledge leads to the formation of methodical habits, or perhaps better, the habit of method. The habit of close observation, association, induction, and deduction, acquired in the handling of one kind of thought-content, may be applied, not so perfectly perhaps, but effectually, to the treatment of any other thought-content, however remote from the first.

"There are results in feeling that are carried over readily from one sphere to others, no matter how remote. Note how a general tone of self confidence once established in the mind of an otherwise diffident child braces up every form of mental activity thereafter. There are moral qualities that, once secured, react on intellectual processes, and acknowledge no such bonds as Ziller imposes. The ardent love of truth and the sense of intellectual responsibility that may be aroused through instruction—what mental activity do they fail to touch with vivifying power?

"So we shall thank Ziller for having moderated

some unreasonable claims and having at the same time pointed out some neglected principles, which it is important for us to observe in instruction. But we are not ready to accept in full the negative side of his argument. We shall still have faith in the far-reaching results of instruction to defy the attempt to confine them within narrow theoretical limits, and shall continue to believe that some of the best things in education are of this kind." [1]

The direct stimulus to the present-day controversy was given by the addresses of Hinsdale in 1894 and 1895 before the National Educational Association. These addresses were widely read and have become, so to speak, a part of our educational inheritance. The following extracts summarize Hinsdale's position:

"The law appears to be this: in so far as the second exertion involves the same muscles and nerves as the first one, and, particularly, in so far as it calls for the same co-ordination of muscles and nerves, the power created by the first exertion will be available. In other words, the result is determined by the congruity or incongruity of the two efforts." "Through repetition, the energizing

[1] Brown (E. E.), *Public School Journal,* December, 1893, "How is Formal Culture Possible?" pp. 194-6. See also Brown's address, *Congress of Arts and Sciences,* St. Louis, 1904, Vol. VIII., "Present Problems in the Theory of Education," pp. 76, 77.

process becomes easier and more rapid. Repeated activity in the same direction tends to groove the mind, or, to change the figure, the stream of activity digs out for itself a permanent channel of discharge. Mental power is of two kinds, specific and generic. In other words, the power that is generated in any activity can be fully used again in the same kind of activity, but only partly used in other kinds—the measure of the difference being the relative unlikeness of the two activities." [1]

The present opinion of the subject is what more closely concerns us here. To illustrate this opinion we quote both from adherents and from opponents to the doctrine of formal discipline. Such a group of quotations seems the most direct and useful way to represent the many-sided discussion of this problem. Out of the wealth of material illustrating the former position, we confine ourselves to five recent quotations, written amid the growing demand for a modification of the old doctrine.[2]

[1] Hinsdale, *Studies in Education*, 1896 (Addresses 1894, 1895), pp. 47, 73.

[2] Further references (two from American and two from British sources) on this side are White, *Elements of Pedagogy*, 1886, pp. 119, 120; Roark, *Economy in Education*, 1905, p. 207; Dexter and Garlick, *Psychology in the Schoolroom*, 1905 Ed., pp. 211, 169; Collar and Crook, *School Management and Methods of Instruction*, 1900, pp. 129, 130.

"The practical aim of a general education is such training as shall enable a man to devote his faculties intently to matters which of themselves do not interest him. The power which enables a man to do so is obviously the power of voluntary, as distinguished from spontaneous, attention.....In other words, whatever interests people commands their spontaneous attention, and accordingly such power of concentration as is naturally theirs. But if a man is to make anything whatever out of a matter which does not interest him, he must concentrate his powers on it by a strenuous act of attention controlled by the full power of his will.....The elder education, to be sure, cultivated voluntary attention, not because it specifically insisted that pupils should unintelligently devote tedious years to grammar and dictionaries of Latin and Greek, or to lifeless variants of the extinct vitality of Euclid; but, unknowingly, it cultivated the faculty well. Through daily hours, throughout all their youthful years, it compelled boys, in spite of every human reluctance, to fix their attention on matters which, of themselves, could never have held attention for five minutes together. No doubt, plenty of subjects other than classics or mathematics could have been made to serve this purpose and could

be made to serve it now. You can hardly imagine a subject, essentially uninteresting, which would not reward plodding work with a similar result—with substantial ignorance of the matter studied, but with increasingly and lastingly muscular power of voluntary attention." [1]

This general value of specific training in voluntary attention is also emphasized in the following discussion by Angell, though the author's point of view is somewhat different from that of Wendell. The article from which the extract is taken does not argue for the transfer of acquired ability beyond the common elements in the processes involved, but it does argue for the very general usableness and importance of many of the common elements in specific training.

"The persistent and voluntarily directed use of attention, especially when the subject attended to is lacking in interest, speedily becomes acutely distasteful. Voluntary attention involves some strain, and this strain, if long continued, is certain to become unpleasant. We first become bored, then restless, and finally find the thing intolerable and abandon it. Now no small part of the discipline which comes from the effortful use of

[1] Wendell, *The Privileged Classes*, 1908, "Our National Superstition," 171-174.

attention in any direction or on any topic is to be found in the habituation which is afforded in neglecting or otherwise suppressing unpleasant or distracting sensations. We learn to 'stand it,' in short. This fact has been pointed out at times by writers on these topics, but it is rarely given the importance which it properly deserves. Anyone can attend to things which interest or please him as long as his physical strength holds out. But to attend in the face of difficulties which are not entertaining is distinctly an acquired taste, one to which children and primitive people always strenuously object. From this point of view it may well be that such studies as the classics and certain forms of mathematics have a peculiar value in affording the maximum of unpleasantness diluted with a minimum of native interest, so that a student who learns to tolerate prolonged attending to their intricacies may find almost any undertaking by contrast easy and grateful. The actual mental mechanism by which this intellectual and moral acclimatization is secured, is extremely interesting, but we cannot pause to discuss it. Certain it is that something of the sort occurs and that it is an acquirement which may presumably be carried over from one type of occupation to another. If each form of effortful

attention had a wholly unique type of discomfort attached to it, this inference might be challenged. But such does not seem to be the case." [1]

As early as 1878 Bain had expressed the same idea: "There is a form of mental efficiency that attaches more or less to every productive effort—the giving attention to all the rules and conditions necessary for the result intended.....This is a discipline that we learn from everything that we have to do; it is not a prerogative of any one study or occupation, and it does not necessarily extend itself beyond the special subject." [2]

The doctrine of formal discipline has recently been restated more or less in its old form by Münsterberg, Cole, Sihler, and Shorey, and in a modified form by Judd.

"The child tries and tries again to grasp and to fixate and to whistle, to read and to write, to jump and to throw a ball, and at a later age to perform complex activities such as typewriting and bicycling. The development is specific; the formal training of the will is general. The will which has learned to resist distractions can hold its own in any field. To be sure, to learn whistling

[1] Angell (J. R.), *Educational Review,* June, 1908, "The Doctrine of Formal Discipline in the Light of the Principles of General Psychology," pp. 9, 10.

[2] Bain, *Education as a Science,* 1878, pp. 141, 142.

with accuracy does not help to ride the bicycle or to run the typewriter. Yet this specific character of the training must not be exaggerated. It is, after all, not only the one specific kind of movement which is trained but the whole group of movements which involve similar activities. In training for baseball, we do not train for football and still less for piano playing. But by training for baseball, we secure general alertness in our motor responses."

"Training of mental activity must be acknowledged as a function of the school certainly equivalent to the mere acquisition of knowledge and the development of inspiration. Moreover, our psychological study showed clearly to us that every mental function can really be developed. Apperception and observation, memory and imagination, attention and interest, imitation and reasoning, feeling and emotion, effort and will, in fact, every function can be rapidly strengthened through systematic training and can degenerate through neglect. One side of mental life must not be crippled in the interest of others, as long as general education is in question."

"A study which is throughout emotionally welcome and naturally interesting may indeed be serviceable for the quick acquisition of a large

amount of material but it neglects the development of that mental function which is most essential for a life of high aim, the voluntary attention. There is no doubt that through the tendency of our time to yield to this demand for interesting instruction, we already feel the dangerous results of the crippling of the voluntary attention. The superficiality which makes so much of the work of our day inefficient has its origin here." [1]

"In our examination of the power of choice between good and evil, we saw that failure to choose wisely is always due to a failure to see straight, to feel truly, to think logically. The aim of education, then, since it can only begin where heredity stops, must be to cultivate these three powers. If education is to help the coming generations not only to get out of the past the best that the past can offer, but also to use this in living their own lives, it should be concerned not only with the handing down of mere facts acquired from the past, but also with the cultivation of power to use facts.....It is true, indeed, that the brain needs a large equipment of ready facts to keep it from unconscious error; but these facts are only to support the application of power: they are absolutely valueless without the power to make

[1] Münsterberg, *Psychology and the Teacher*, 1909, pp. 192, 264, 265.

use of them. They are subordinate to the reasoning faculty. A large part of the teaching of facts in recent years has assumed that facts are valuable for their own sake, and has been conducted in such fashion as to prevent the development of the power of reasoning. The facts have been made unduly easy to learn, and the power to see, to ponder, to reason, has been stagnating from disuse. Our young people have been left without the power to apply their learning to their own problems, to see things in wholeness and in due relation one to another, and to distinguish a reasonable proposition from an absurd one. To remedy this must be the first educational reform, and fortunately it seems already to be coming." [1]

"Another fatuous and evil thing was *the artificial creation of educational, academic, cultural equivalents,* counting, mainly, by equivalents of time. Now I do not claim all virtue for difficulty and labor *per se,* though the simple truth must never be left out of sight that sustained exertion creates strength, and that there is the phenomenon of 'soldiering' in college life as well as among artisans." "If, in the domain of physical training, a handful of youth only were to be seen exer-

[1] Cole, *American Hope,* 1910, Chap. I., "The Training of Powers," pp. 99, 100.

cising at the parallel bars, while veritable mobs were playing mumble-the-peg on the green, we would have a fair *analogon* to illustrate the earnestness and strenuosity begotten by this glorious elective system."

"Excellence (not easily attainable mediocrity or mere passing) has become rarer among our youth, as the numbers in the colleges increase. To sum up, in conclusion, we must return to the clear and definite precincts of liberal education; and the deeper meaning of the same would seem to be this: not in training for a trader or a broker, not in the great and useful lines of technology, not in æstheticism or in the contemplation of the beautiful; it is concerned, intrinsically, with no ulterior form of power and profit, but with the training and forming of the higher, nay, of the essentially human, powers, viz., to think, to reflect, to reason, to argue, to weigh, to recall, to review, to compare, to marshal in order, to arrange and coördinate, to utter and prove, to appeal and to lead." [1]

"The education of those who can afford time for non-vocational study is not in the narrower or more immediate sense of the words a 'preparation for life,' but, from the point of view of the indi-

[1] Sihler, *New York Evening Post,* October 1, 1910, "The Elective System."

vidual, a development of the faculties; from the point of view of society, the transmission of a cultural, social, moral tradition. It must be a broad discipline of the intellectual powers that shall at the same time attune the æsthetic and the moral feelings to a certain key. No study but that of language and literature can do this, and it is best done through an older and more synthetic form of language and literature, that is, in relation to the student and his environment, classic. This is the meaning of the late W. T. Harris's somewhat cryptic Hegelism that self-alienation is necessary to self-knowledge. Or to put it more concretely, the critical interpretation or translation of such a language supplies the simplest and most effective all-round discipline of the greatest number of the mental faculties."

"To-day there is no science of psychology, sociology, or pedagogy that can pronounce with any authority on either the aims or the methods of education. The confident affirmations of our colleagues in these departments are not, then, to be received as the pronouncements of experts, but as the opinions of observers who like ourselves may be partisans. . . . . There is no proof by scientific experiment and ratiocination that mental discipline is a myth, and no prospect of it. There

are in general no laboratory experiments that teach us anything about the higher mental processes which we cannot observe and infer by better and more natural methods. Still less are there any that can even approximate to the solution of the complicated problem of the total value and effect of a course of study. There is no authentic deliverance of science here to oppose to the vast presumption of common-sense and the belief of the majority of educated and practical men." [1]

"We have been in the habit of saying that this or that kind of knowledge is valuable, and we have not really meant this or that kind of knowledge, but this or that subject-matter. I believe it is time for us to take an entirely different view of what is meant by the term *kinds of knowledge*. The ability to reason independently, the ability to retain the essentials and neglect the non-essentials, the ability to carry on certain types of inquiry in any subject-matter, all these forms of ability are more important than the ability to reproduce a body of particular information. The meaning of this last contention may be made somewhat clearer by saying that what we need in our examination of the high-school course of study is a

[1] Shorey, *School Review*, November, 1910, "A Symposium on the Value of Humanistic, Particularly Classical, Studies: The Classics and the New Education: III. The Case for the Classics," pp. 598, 607, 608.

complete restatement of the value of these courses in terms of the mental habits which are cultivated as distinguished from the information which is gained. We are just at the beginning of a period of study of the effects of education. We should begin this study by getting some comprehensive notion of the different faculties or different types of mental life which can be regarded as advantageous. Instead of making the general sweeping statements about the value of certain subjects of instruction we ought to ask how the power to reason can be cultivated, how observation can be improved and widened in scope. In short, we ought to have some classification of our achievements in the educational world which would make it possible for us to talk intelligently about the traits of mental character which have been cultivated. The moment I put the matter in that way I am sure you will all recognize my position on the much-discussed problem of formal discipline to which I am referring.....It is very interesting to note that the assertions which have been made regarding the non-existence of formal discipline have been based very largely on studies of simple elementary-school subjects. The examination of neatness in arithmetic work has been one of the matters of discussion. The question

whether arithmetic and geography are related or unrelated has been another one of the subjects of discussion. If anything is clear with regard to the problem it is that the final answer to this question will relate not so much to the work of the elementary school as to the work of the high-school. There is no doubt at all that the child in the elementary school is very dependent upon the new information which he acquires in any given subject. Furthermore his interests are relatively unsettled and his powers of concentration weak. The result is that the conflicts which exist between the various subjects of instruction in the elementary school are so great that the information which can be gathered with reference to that period of education is of relatively small importance in solving for us the broader general problem of education which presents itself to the high-school teacher. Formal discipline is and always will be a matter of very much greater concern to the high-school teacher than to the teacher in the elementary schools. If this statement is true it follows immediately that we must solve this problem through an examination of high-school subjects and their interrelation.....The problem can never be solved except by a re-examination of the subjects of the high-school with reference to the general

faculties which they are supposed to train, rather than with reference to the subject-matter itself." [1]

Our second group of quotations is from authors who emphasize the *specific* character of mental discipline, although granting the wide usableness of the effects of training through the identical elements, in many functions, of subject-matter, method, etc.

"The mind is by no means a collection of a few general faculties, observation, attention, memory, reasoning and the like, but is the sum total of countless particular capacities, each of which is to some extent independent of the others,—each of which must to some extent be educated by itself. The task of teaching is not to develop a reasoning faculty, but many special powers of thought about different kinds of facts. It is not to alter our general power of attention, but to build up many particular powers of attending to different kinds of facts. . . . . .

"Training the mind means the development of thousands of particular independent capacities, the formation of countless particular habits, for the working of any mental capacity depends upon the concrete data with which it works. Improve-

[1] Judd, *School Review*, February, 1910, "On Scientific Study of High-School Problems," pp. 93-5.

ment of any one mental function or activity will improve others only in so far as they possess elements common to it also. The amount of identical elements in different mental functions and the amount of general influence from special training are much less than common opinion supposes. The most common and surest source of general improvement of a capacity is to train it in many particular connections."

"Identity of Procedure. The habit acquired in a laboratory course of looking to see how chemicals do behave, instead of guessing at the matter or learning statements about it out of a book, may make a girl's methods of cooking or a boy's methods of manufacturing more scientific because the attitude of distrust of opinion and search for facts may so possess one as to be carried over from the narrower to the wider field. Difficulties in studies may prepare students for the difficulties of the world as a whole by cultivating the attitudes of neglect of discomfort, ideals of accomplishing what one sets out to do, and the feeling of dissatisfaction with failure." "In the case of the features of attitude and method, taking special pains that they are taught means in practice requiring their application to varied situations, for we can never be sure that a general idea or ideal or atti-

tude is gained until we test it in application. Moreover in nine school children out of ten the only way that an ideal or attitude does become general is by being derived from and again applied to many different particular cases. To make ideals and attitudes operative in all fields the teacher must give them exercise in at least several fields." [1]

"It is agreed that wherever practice in one exercise leads to improvement in another certain specific elements in both are identical and call forth identical responses which promote success in both exercises. The identical elements that are thus distinguished may be divided into two groups, those of content and those of form. As examples of content elements we may mention sounds, colors, letters, nonsense syllables, words, objects, kinds of geometrical figures, standards of measurement, ideas, etc. As one grows familiar

[1] Thorndike, *Principles of Teaching*, 1906, Chap. XV., "Formal Discipline," pp. 240, 248. Similar opinions have recently been restated by Thorndike in his *Educational Psychology*, 1910 Ed., Chap. IX., "The Relations between the Amounts of Different Traits in the Same Individual," pp. 186-8. "Modern psychology has sloughed off the faculty psychology in its descriptions and analyses of mental life, but unfortunately reverts customarily to it when dealing with dynamic or functional relations. But it is just in the questions of mental dynamics and of the relationships of mental traits that we need to bear in mind the singularity and relative independence of every mental process, the thoroughgoing specialization of mind. The mind is really but the sum total of an individual's feelings and acts, of connections between outside events and his responses thereto, and of the possibilities of having such feelings, acts and connections."

with such elements, the power to remember them and to attend to them when they appear in new situations and to do what they suggest increases. The elements of form may be said to consist of the characteristics that the various situations present as problems for the attacking mind. Thus we recognize one situation as a problem of memorizing where from the nature of the material a particular method of committing to memory may be especially useful. Again, we recognize the need of particular adjustments of perception, such as movements which we have already practised. All situations demand adjustments of attention, some of which may invariably be necessary, while others may suit especially specific kinds of material.

"We observe that elements of form and elements of content are equally specific, equally capable of definition. Moreover, both are capable of generalization—that is, both are capable of appearing in a variety of settings. The problem of general training is, then, quite as much one of discipline in content, as it is of discipline in form. A better division of mental discipline for our purposes would be into two phases which we may denominate specific discipline and general discipline. Specific discipline consists in the analysis of the specific elements which are to be found to

be critical in determining certain reactions, and in the practice by which the appropriate reaction is made the habitual response to each element thus discriminated. General discipline consists of training in the recognition of these critical elements in a variety of situations." [1]

"By a discipline of body we mean that through exercise of function and experience of a given sort a tendency or potentiality for action in that direction is produced..... Correspondingly the mind when habituated to given ways of functioning is trained or disciplined in those directions..... Inasmuch as any physical work, no matter how complex, is made up of simple elements, it also follows that these elements can be woven into manifold new combinations. Whenever a new activity involves an element already learned that part of the process does not need to be again mastered. However, it must be recognized that not only the element, but also its connections have to be considered..... Similarly with mental operations. Almost any study involves elements that have been mastered in other connections. These elements are immediately serviceable..... But it must not

[1] Henderson, *Education*, May, 1909, "Formal Discipline from the Standpoint of Analytic and Experimental Psychology," pp. 609, 610. These paragraphs are repeated in Henderson, *Text-Book in the Principles of Education*, 1910, Chap. X, "The Question of Formal Discipline."

be forgotten that the combination of old, and even perfectly familiar, elements is a difficult matter in itself. Old combinations may even be a hindrance, especially if too fixed. Bad habits of walking, talking, writing, singing, or thinking are harder to modify than new ones are to inculcate. .....Most subjects of instruction have a great many similar elements. As far as they have similar elements they are valuable for each other. The greater the number of identical elements in the two, the greater the value.

"Next in value to the elements of old knowledge which are utilized in learning new things there are certain ideals and attitudes toward work. There are no general faculties of attention, memory, and reason, which attend, memorize, and reason about one thing as well as another by simply 'connecting them up.' But there are habits of attending to things, of trying to memorize, trying to reason; in short, habits of striving for excellence, which are no mean possession. In fact, oftentimes the ideals of excellence and of application to duty are among the most valuable assets which the schoolboy acquires." [1]

[1] Bolton, *Principles of Education*, 1910, Chap. XXVIII., "General Discipline and Educational Values," pp. 757–9. An informal article by Bolton in the *School Review*, February, 1904, "Facts and Fictions Concerning Educational Values," foreshadowed this lengthy discussion.

"In any event, it is desirable that the teacher should rid himself of the notion that 'thinking' is a simple unalterable faculty; that he should recognize that it is a term denoting the various ways in which things acquire significance. It is desirable to expel also the kindred notion that some subjects are inherently 'intellectual,' and hence possessed of an almost magical power to train the faculty of thought. Thinking is specific, not a machine-like, ready-made apparatus to be turned indifferently and at will upon all subjects, as a lantern may throw its light as it happens upon horses, streets, gardens, trees, or river. Thinking is specific, in that different things suggest their own appropriate meanings, tell their own unique stories, and in that they do this in very different ways with different persons. As the growth of the body is through the assimilation of food, so the growth of mind is through the logical organization of subject-matter. Thinking is not like a sausage machine which reduces all materials indifferently to one marketable commodity, but is a power of following up and linking together the specific suggestions that specific things arouse."

This article might well have been represented in the quotations in our first edition; but when we first saw the article we had already outlined our discussion and had selected quotations expressing in a more compact way the main ideas discussed by Bolton.

"The so-called faculty-psychology went hand in hand with the vogue of the formal-discipline idea in education. If thought is a distinct piece of mental machinery, separate from observation, memory, imagination, and common-sense judgments of persons and things, then thought should be trained by special exercises designed for the purpose, as one might devise special exercises for developing the biceps muscle. Certain subjects are then to be regarded as intellectual or logical subjects *par excellence,* possessed of a predestined fitness to exercise the thought-faculty, just as certain machines are better than others for developing arm power. With these three notions goes the fourth, that method consists of a set of operations by which the machinery of thought is set going and kept at work upon any subject-matter.

"We have tried to make it clear in the previous chapters that there is no single and uniform power of thought, but a multitude of different ways in which specific things—things observed, remembered, heard of, read about—evoke suggestions or ideas that are pertinent to the occasion and fruitful in the sequel. Training is such development of curiosity, suggestion, and habits of exploring and testing, as increases their scope and efficiency. A

subject—any subject—is intellectual in the degree in which *with any given person* it succeeds in effecting this growth. On this view the fourth factor, method, is concerned with providing conditions so adapted to individual needs and powers as to make for the permanent improvement of observation, suggestion, and investigation." [1]

"Thinking power is not an abstract and general power of the mind to be applied equally well in all sorts of situations. It is rather a function of some larger whole, varying with the degree of development of that larger whole. That larger knowledge includes special knowledge of facts and special training in the technique of the subject. The good thinker in mathematics may be a very poor thinker in economics or sociology, and vice versa. The habit of care in the examination of data, in the analysis of a situation, etc., may be carried over from one department to the other, but the special knowledge and the training in the special technique of one may be of little or no use in the other. The thinking process falls within systems of organized fact, as well as being a factor in the organization of material."

"If these things are so, we delude ourselves when

[1] Dewey, *How We Think*, 1910, pp. 38, 39, 45, 46. Dewey's address in *Science*, January 28, 1910, on "Science as Subject-Matter and as Method" leans a little toward formal discipline.

we think of such a thing as training children to think apart from the process of building up a body of knowledge. Again, there may be subjects of study which we feel are valuable because of the fact that they are specially adapted to the training of the child to think. But if the stock of ideas in which this subject deals is one which will seldom or never be drawn upon in his thinking in any other connection than as a subject of study, of what value does this training in thinking become to him? If we are to train children of any age to think, one of the factors in this process is the building up of a system of definite and exact knowledge of facts within the sphere in which the problems of thought are to arrive." [1]

The following scattered references for the year 1910 show that the theory of specific disciplines is becoming more and more influential in educational literature, even when the problem itself is not definitely discussed. Snedden [2] makes it the basis for a plea for special vocational training as distinguished from the so-called cultural education, "vocational efficiency being something to be attained by specialized endeavor, and along lines de-

[1] Miller, *Psychology of Thinking*, 1909, p. 149.

[2] Snedden, *Problem of Vocational Education*, 1910, "The Relation of Vocational to Cultural Education," pp. 71–7. See also Main, *Educational Agriculture*, 1910, Western State Normal School, Hays, Kansas.

termined by its needs." Arnold [1] inveighs against the influence of the theory of formal discipline in over-emphasizing some subjects as "essentials" for the classification and promotion of school-children. His own conclusion is that "by the 'essentials' is meant basic elements in all subjects rather than amplified matter in a few." In outlining some experiments on memory, Whipple [2] says that "the *transfer of practice* from the specially trained form of memory to other forms of memory would appear, from theoretical grounds, to be limited to those cases in which the material, content, or form of procedure of the other forms were related to the material, content, or form of procedure of the trained form." In outlining experiments to be carried out in teaching educational psychology, Dearborn [3] gives the following directions for experiments on the "transference of practice." "Further tests on the general influence of special practice of the sort indicated in the preceding experiments may also be made in memory and by repeating the usual experiment at first employed by James. Before beginning the practice with vocabularies or other matter—which

[1] Arnold, *School and Class Management,* Vol. II., 1910, "The Theory of Formal Discipline," pp. 59–65. See also Colgrove, *The Teacher and the School,* 1910, pp. 125, 350.

[2] Whipple, *Manual of Mental and Physical Tests,* 1910, p. 384.

[3] Dearborn, *Journal of Educational Psychology,* September, 1910, "Experiments in Learning," p. 387.

is usually spoken of as the *practice series*—the student may commit to memory a limited amount of other sorts of material and by learning a similar set after the end of the vocabulary practice—this is the *test series*—may note the effect of the practice on the latter. These results should be checked by having another class or a part of the same class learn the test material at the same intervals of time, but without doing the practice series. It may thus be at least roughly determined how much of the improvement is due to the test series itself and how much to the practice."

Finally, we make a third group of quotations, those from authors who combine both adherence and opposition to the doctrine of formal discipline. These authors take about the same position as do those of the second group, but they lay greater emphasis upon the extended usableness of the common elements of subject-matter and especially of method in many functions. There is little reason for the third group to be considered as upholders of the doctrine of formal discipline and as opposed to the doctrine of specific disciplines. And there is also little reason for one group to criticise the other. They both really modify the old formalist doctrine for the same reason, limiting the transfer of acquired ability

to the common elements in the processes involved. However, the critics of the third group have done good service in cautioning against extremes and in suggesting many relations between functions, which were not thought of before.

"*Each of the numerous habits of the brain means tendencies to the excitement of localised tracts and paths under given physical conditions.* An excitement passing over one set of paths leads to one system of external movements, *e. g.*, from eye centre to hand centre, when one sees and then grasps. If circumstances vary the paths, they vary the motor results.....Whatever has happened to the brain in the past has meant some definite and usually sharply localised interchange of induced activities among its elements. Every such interchange has altered the minutest structure of all the elements concerned, has established localised paths between them for future inductions to follow. They can never act again precisely as they would have done had they not acted once in just this way. And this is what is meant by saying that the brain *forms its habits*. One must now, in addition, note that this formation of habits may occur in the most subtle fashions. Parts that have often functioned together tend to function more

easily together again. This is true down to the minutest detail of localised functions. But what is still more significant for all our higher mental life is, that *general forms or types of activity, however subtle their nature, when once they have resulted from a given exchange of induced activities (due to sensory stimulations), may tend thereby to become henceforth more easily re-excited, so that habits of our brain may come to be fixed, not merely as to the mere routine which leads to this or to that special act, but as to the general ways in which acts are done.* A given 'set' of the brain as a whole, that is, a given sort of preparedness to be influenced in a certain way —yes, even a given tendency to change, under particular conditions, our more specific fashions of activity—may thus become a matter of relatively or of entirely fixed habits.....It is indeed true that, owing to the localised character of the phenomena which determine single habits, the training of one specialized cerebral function, in any particular case, *may not* result in the training of some other specialized function, even where we, viewing the matter from without, have supposed that these two functions were very intimately connected. The question as to *what* effect

the training of any one special function will have upon other functions, or upon the general tendencies of the brain, is therefore always a question to be answered by specific experience. This the teacher, in estimating the effects of new educational devices upon the pupils, must always remember." (Royce.)[1]

"Training in any exercise that requires skill undoubtedly increases more general habits of accurate perception and methods of eliminating useless movements that are transferable to other movements with other parts of the body. So, too, with memory, in the usual logical learning the factors involved are in large measure common to memories of related subjects. You cannot be sure that any fact is absolutely unrelated to any other, and so far as they are related, learning the one makes easier learning the other. In both rote and logical learning there are definite habits and capacities of attending to be acquired, and these may apparently be acquired in one field, and used in another. We have to do in memory, then, with a large number of fairly distinct physiological capacities, but their use has become so dependent upon habits common to the different capacities that they are functionally parts of a common

[1] Royce, *Outlines of Psychology*, 1903, pp. 67-70.

whole. Training one part thus trains related parts, and the whole in some degree." (Pillsbury.)[1]

"To affirm that when the mind is trained in one direction it is first of all trained in that direction and not in some other is one thing; to affirm, however, that the training in one direction has no influence in other directions is quite a different affair. No one, I think, would be quite so rash as to make the latter assertion; but many would believe that such a transfer of training is in most cases slight, and in some cases such a transfer is not probable, even in the slightest degree..... Such persons may try to bring definiteness into their conceptions as to the extent of this transfer, by saying that such a transfer can take place where there is a similar situation, and where like elements are involved; but it must be remembered that similarity and likeness are not primarily objective categories, but that they are constituted by the mind of the person who finds such similarity or likeness, and that it is never certain beforehand just where this similarity and likeness is to be found."

"Transfer of training is possible in the ways indicated: (1) Where a single element to which a

[1] Pillsbury, *Educational Review*, June, 1908, "The Effects of Training on Memory," pp. 26, 27.

specific response is made functions under various environmental conditions because it is a common element in these various, and otherwise to a greater or less degree, dissimilar environments; (2) When a dominant mood or emotion so colors various environments that a characteristic response is obtained without identity of any one objective condition; (3) Where a single response in reality involves other and more general adjustments; (4) it is also possible, as Bagley suggests, through making the end of the activity a clearly conscious ideal. In this case the transfer takes place by a direct carrying over by consciousness not of the activity itself, but of the purpose of the activity, to another field."

"I believe that it is possible in the light of all the evidence presented on the subject of transfer to lay down with tolerable certainty a few rules of procedure. (1) The first rule should be: Make those specific activities which you wish to transfer the object of thought. Let the significance of the habit and its general bearings become known to the person who is the subject of the training..... (2) Train the child in the technique of learning and in the processes that make learning effective and economical. Nearly all the investigations emphasize the value of properly

adapted attention, of satisfactory physical and mental attitudes in securing transfer. Sustained attention should be developed in the school training, not merely for the sake of the object attended to (perhaps not primarily for the object's sake), but rather for the sake of attention itself..... (3) In seeking to secure transfer, especially where purpose does not play an important part, see to it that the stimulus which is to call forth the desired reaction is such that it may be a common element in many objective situations..... (4) Education should cultivate through specific training general emotional attitudes. Moods and feelings often are the dominant elements in a situation and these can be readily transferred, I believe."

The author then makes application of his theories in discussing the comparative disciplinary values of pure and applied science. "My own conclusions would be that pure science is of greater disciplinary value because (1) through the facts which it presents, ideas of procedure and of truth may be developed which function in a wider human experience, greatly to the uplift of the race; (2) the content and method of pure science is such that it has a broader field of application than has applied science, and can function as an identical or similar element in more situations than can applied

science; (3) the emotion which the pure seeking after truth arouses is higher and less likely to be deadened by other emotions than are the ideals of economic improvement and social betterment, which are the aims of an applied science." [1]

"Three points will show the possibilities of benefit from special training beyond the specific line of reaction subjected to practice. 1. The habit pathways may altogether or in part be common to two or to many operations perhaps *externally* very different.....2. The method of procedure in a special habit may evidently be applicable to a much larger field.....3. Mental attitudes or ideals tend by chance variation and by suggestion to extend their sphere of action.

"With this threefold possibility in mind, it is evident that there are three principles for the teacher to follow, each with a retinue of many corollaries. (a) He may select in a given field habits fundamental or common to the widest range, and drill on similar applications of these habits, while at the same time avoiding the habits that would interfere. (b) He may secure valuable methods of procedure and emphasize the attitude of mind as generally important in life. Narrow-

[1] Colvin, *Some Facts in Partial Justification of the So-Called Dogma of Formal Discipline*, 1909 and 1910, University of Illinois.

ness, formalism, dogmatism, and a host of unfortunate elements in the method of procedure are to be avoided, while breadth, organization, criticism, and others advantageous are to be retained. (c) Finally he may not only develop definitely the ideals of action as generally applicable and to be applied, but may also increase the suggestibility of the habit taught, by substituting for chance suggestion specific applications in as many directions as possible, thus extending the likelihood of future application. Breadth of knowledge and of training will count very greatly in widening out a teacher's work and filling it with suggestion. It is evident that reviews from varying points of view, and other schemes for assisting the child to generalize or organize, all add to the possibility of suggestion." [1]

A doubtful middle position between theories of general discipline and of specific disciplines is that shown by Charters in discussing "the specific and tonic functions of subject-matter." "Just as quinine has a specific function in its selective action upon poisons of the blood in malaria and kindred diseases, and has also a tonic action upon the whole body as a result of this specific action, so the

[1] Rowe, *Habit-Formation and the Science of Teaching*, 1909, pp. 243-250. There is confusion here between (b) and (c).

study of subject-matter has both a specific and a tonic function.[1] Each unit has a specific point of attack, a particular problem to solve, or need to satisfy, and in addition, the acquisition of the unit produces a certain exercise of the whole mental system somewhat general in its action and elevating to the tone of the system..... In all these cases we are able to discriminate between the value which is being *consciously* pursued and the wider, more indefinite systemic values which flow from the effort necessary to carry out this specific function, values of which the one putting forth the effort is, perhaps, quite unconscious..... For the most part, the term 'tonic' refers to the fact that the way in which some of these values are gained and, particularly, the disciplinary value, is by the exercise of mental processes which are heightened in tone by the very fact of being exercised." [2]

[1] But the effects of mental training do not circulate in the blood as do the molecules of quinine taken as medicine.

[2] Charters, *Methods of Teaching*, 1909, pp. 37-9.

CHAPTER III

REVIEW OF EXPERIMENTS

Space will not allow descriptions of all the experiments so far made, which furnish evidence in regard to the doctrine of formal discipline. Rather than give a brief summary of each experiment, we have deemed it more profitable to describe typical and important ones, using as far as possible the words of those who conducted them. We have not considered it wise or even just, at this stage of the investigation, to enter into a detailed criticism of these experiments; but we have tried to select the most valuable experiments, have let the experimenters speak for themselves, and have left to the reader the responsibility of weighing their evidence. Care has been taken to describe experiments which seem to favor the doctrine of formal discipline, as well as those which seem to oppose it. The results of the other experiments are briefly stated in the summaries mentioned. We are not specially concerned with the large number of experiments on

the effect of practice and the formation of habits is only one function. The reader is referred to the recent summaries of these by Ellison,[1] Bagley,[2] and Whipple.[3] Our special concern is with experiments on the *transfer* of the effect of practice from one function to another. Summaries of most of these latter experiments are given by several of the authors mentioned in our bibliography.

Although the experimenters variously interpret the bearing of their results on the doctrine of formal discipline, they differ mainly as to the extent to which the effect of practice in one function can be transferred to other functions having elements in common with it. This transfer results in either improvement of or interference with the other functions, according to whether the common elements are used in a similar or in a different way in the associations of these functions as compared with those of the first. As some elements are common to many functions, practice with them results in abilities of wide usableness. This widespread transfer has caused many students to overlook or even deny the specific character of

[1] Ellison, *Pedagogical Seminary,* March, 1909, "The Acquisition of Technical Skill."

[2] Bagley, *Psychological Bulletin,* March, 1909. "The Psychology of School Practice."

[3] Whipple, *Manual of Mental and Physical Tests,* 1910.

the habits thus usable in many associations. Especially is this true in regard to elements of method, because they are usually common to more functions than are elements of subject-matter, the number of distinct methods being more limited and their range and applicability wider.

There have been several experiments on cross-education, or the improvement in an activity, involving one part of the body, as the result of improvement through practice in a similar activity, involving a bilaterally symmetrical part of the body. The results of most of these experiments have been summarized by Davis [1] and the writers previously mentioned. The improvement in the second activity in such experiments can be explained as due to two causes. In the first place, both activities are very similar and probably involve in part the same centres in the nervous system. Though bilaterally symmetrical parts of the body are controlled in part through cortical centres in different hemispheres, they are also

[1] Davis, *Yale Psychological Studies,* 1898, "Researches upon Cross-Education." We have not considered it necessary to refer separately to the several American and German experiments on cross-education, as they are all more or less similar in principle. They can easily be found by reference to the bibliographies and summaries mentioned. The allusion in the *Pedagogical Seminary,* January, 1910, to German experiments on transfer must have referred only to those on cross-education, as those by Ebert and Meumann are the only ones on other phases of transfer that we have been able to find. We know of no French experiments on these other phases of transfer.

probably controlled in part through lower centres which serve for both sides of the body. The improvement in the second activity is therefore probably due to the use in part of the same centres in both activities. In the second place, the improvement is due to the working out, in connection with the first activity, of a *method* of *how* to perform the act, and then to the use of this method in guiding the second activity.[1] The use of this method in guiding the second activity is as different from the transfer of acquired ability as the knowledge of how to do is different from the ability to do. Such knowledge may lead to ability, but in itself it is not ability. (See our later discussion of both these points.) The first five experiments here described represent the methods and results of all those on cross-education.

1. The following experiments were conducted by Smith at Yale University, under the direction of Scripture:

"The measure of accuracy was the ability to insert the needle into a single hole 0.1285 inches in diameter. The vertical metal plate containing the hole was placed directly in front of the observer; the right fore-arm was rested on the edge of the table; the stick was grasped like a pencil

[1] Book, *Psychology of Skill*, pp. 109 (note), 166.

and by a steady movement of the hand and wrist the metal point was inserted in the hole. Any contact of the point against the side of the hole was counted an error. The per cent. of successful insertions was considered the measure of accuracy.....

"The first set consisted of twenty experiments with the left hand; the result was 50 per cent. of successful trials. Immediately thereafter twenty experiments were made with the right hand, with a result of 60 per cent. of successful trials. On the following day and on each successive day two hundred experiments were taken with the right hand, the same conditions in regard to time, bodily condition and position in making the experiments being maintained as far as possible. The percentage of successful trials ran as follows: 61, 64, 65, 75, 74, 75, 82, 79, 78, 88.

"On the 10th day the left hand was tested with twenty experiments as before, with 76 per cent. of successful trials, thus showing an increase of twenty-six per cent. without practice in the time during which the right hand had gained as shown by the figures above.....

"From the results of these two thousand experiments the following conclusions seem justified:

(1.) Steadiness of movement can be increased by practice.

(2.) This increase of steadiness is not limited to the control of the muscles immediately trained but affects the control of the corresponding muscles on the opposite side of the body.

(3.) This training seems to be of a psychical rather than of a physical order and to lie principally in steadiness of attention." [1]

2. The following experiments were conducted by Davis with six graduate students at Yale University:

"At the initial test the subject's clothing was removed from the upper part of his body. His weight was then taken and his strength of forearm, or grip, measured by the usual spring dynamometer. The following measurements were then made: right and left upper arm both flexed and extended; right and left forearm with and without the hand clenched. These measurements were taken at the largest circumferences of the arm above and below the elbow. The weight (a 2½ kilo. dumbbell) was then given to the subject, who was instructed to lift it from a position where

[1] Scripture, Smith, and Brown, *Yale Psychological Studies*, 1894. "On the Education of Muscular Control and Power," pp. 115-118.

the arm hangs extended downward and the weight is supported from the shoulder, to one where the arm is flexed and the weight close to the shoulder. In this movement the elbow remains stationary. Hence, to accomplish this act, the biceps is employed almost wholly, though the muscles of the forearm are also used to a lesser extent in gripping the dumbbell. This gripping was intensified toward the end of the test, when the subject became fatigued.....

"The subject then entered upon a practice extending from two to four weeks; this consisted in simple flexions of the *right arm* with the weight.....

"At the final test the same data were obtained in the same way and under the same conditions as at the initial test. Additional data were also obtained."

The following summary gives the results of several tests made of the right and the left arm, before and after practice of the right arm with the dumbbell. The six subjects averaged 26½ years of age, 14½ days of practice, and 310 flexions of the right arm in daily practice. The average girth gain in mm. of biceps, contracted, was —right 6 1/3, left 2 5/6; the average girth gain of forearm, contracted, was—right 4 5/6, left 2 1/6;

the average gain in number of flexions made with the dumbbell was—right 757, left 178; the average gain in strength of grip as measured by the dynamometer, in kilos, was—right 5.56, left 5.41.

The author gives the following conclusions from his own experiments and those made by others:

"a. The effects of exercise may be transferred to a greater or less degree from the parts practiced to other parts of the body. This transference is greatest to symmetrical and closely related parts.

"b. There is a close connection between different parts of the muscular system through nervous means. This connection is closer between parts related in function or in position.

"c. Will power and attention are educated by physical training. When developed by any special act they are developed for all other acts.

"With conclusions *b* and *c* established the explanation of the transference is probably reached. There is no doubt that the most important effects of muscular practice are central rather than peripheral. The central effects may be distinguished as: (1) those dependent on the development of motor centres, that is, their improvement through exercise; (2) those dependent on the development

of physical factors, notably attention and will power. Of these two effects we would emphasize the first as the most important." [1]

3. With three or four subjects Bair made a large number of experiments in typewriting and various other movements in order to measure "the interference taking place when a sense impression or a series of sense impressions to which we have previously responded with a movement or series of movements are now responded to by a different movement or series of movements." The author's conclusions most pertinent to our problem are as follows: "If after the responses have been repeated many times to a certain serial order of stimuli, and then either the order of the stimuli, the order of responses to stimuli, or both, are changed, there will be a considerable rise in the practice curve, of errors when the time is kept constant, or of increased time when the errors are kept constant.....In none of these three cases, however, when, in one order, a number of practices sufficient to approach the proficiency limit were made, did the curve rise as high, when the change was made as it started in the first practice." This difference between the rise due to supposed in-

[1] Davis, *Yale Psychological Studies,* 1898, "Researches upon Cross-Education," pp. 18-29, 49, 50.

terference and the greater rise in the beginning of the first practice, Bair attributes to the transfer of the effects of practice. "If our results justify us in drawing any conclusions, we might say that special practice or training gives general ability, or learning to do one thing gives us capacity to do other things, or the same thing in different ways." [1]

4. The following experiments were made by Swift with five University students in "keeping two solid rubber balls going with one hand, catching and throwing one while the other is in the air."

"The daily programme consisted of ten series, the subject in each case continuing the throwing until he failed to catch one or both of the balls. This constituted one series. The number of catches made in each series was immediately recorded, with any data obtainable as to the method pursued and the cause of failure.....All the subjects knew their daily score, and they always kept track of their progress during each test as well as from day to day.....The daily training was continued in the case of four subjects until the average number of catches for each series exceeded 100, or, what amounts to the same thing, 1,000 catches in ten series, for two days in succession."

[1] Bair, *Psychological Review Monographs*, 1902, Vol. V., No. 19, "The Practice Curve," pp. 39, 45.

"The throwing and catching of the regular tests was with the right hand (all the subjects were right-handed), but in order to ascertain the effect of right-handed practice upon the skill of the left hand, a preliminary test was made upon each subject, on the first day of his practice, of his untutored skill with the left hand. This preliminary test consisted of ten series as usual; and after this the left hand was not again tried until after the completion of the whole period of work with the right hand, when the left hand was again tested and a record of its progress kept for a number of days."

"1. The record of the first day of regular left-hand training is in all cases higher than the preliminary test, though in no case had the left hand been practiced with the balls during the interval. More than this, the score never drops to the level of this preliminary test, which shows that the gain was permanent.

"2. The left-hand curves bear a striking resemblance in general form to the corresponding right-hand ones, with this difference that in all but one case they ascend much more rapidly.....

"3. All of the subjects made a better score with their left hand on the first day of its regular

practice than they had been able to do with their right at the beginning of the work."

"The conclusion is unavoidable that in the majority of cases the training of the right hand was somehow effective upon the left also. The same general result has been noticed by many observers engaged in different lines of investigation. The chief point of interest is to discover how the effect is produced. Is it due to some purely peripheral change, or to some alteration in the central nervous system, or, finally, to some method or plan of work that may be applied equally well in the case of either hand, as, for example, the knowledge of spelling which a man could use as well in writing in mirror script as in the ordinary way? It is not impossible that cases could be found that would exhibit the co-operation of all three. In the ball-tossing there was evidence, certainly, of the last two. All the subjects were able to make use with the left hand of the methods of handling the balls, and of recovering control of them after an ill-directed throw, which had been developed in the right-hand practice. In all the cases but one a good deal of less conscious facility (of a sort that might indicate some kind of symmetrical training of the central nervous system) was probably pres-

ent. The subjects were able at once to build in the sub-structure of central (or neuro-muscular) skill, and so to learn the art of left-hand throwing much more quickly than the right. The mental element, the power to comprehend and meet a situation, is evidently, then, in most cases, the more difficult part of the complex muscular feats of skill, since the right hand, if taken first, needs so much more time for the learning than the left, notwithstanding its greater general facility in such movements in right-handed people."

"It would be a mistake to suppose that such experiments in cross-education give support to the doctrine of 'formal education.' There is no evidence to show that training has general value. Indeed, it all argues strongly for the influence of content.....The right hand has had a great variety of training that ought to bring it along rapidly in ball-tossing on the principle of formal training, but this investigation shows just the reverse. The right hand learns it very slowly, but the special training that comes from doing a specific thing, enables the left hand, awkward and stiff as it is, to get control of the situation in about one-third of the time required by the right. Skill in certain lines may be serviceable in other similar

processes, but its value decreases as the difference between the kinds of work increases, and in many cases it is probably reduced to zero." [1]

5. A recently reported experiment on cross-education is that by Starch: "The experiment consisted of tracing the outline of a six-pointed star as seen in a mirror. . . . . The experiment as performed by the students is as follows: (a) Tracing one-half of one outline with the left hand. (b) Tracing ten complete outlines with the right hand. (c) Tracing another half with the left hand. The results are then tabulated to show the exact time and number of errors of each tracing."

"The effect of practice with the right hand upon the left hand is very considerable. One tracing was made with the left hand before and one after the practice with the right hand. The improvement with the right hand from the first to the last record (100) was 84 per cent. in time and 92 per cent. in errors, average 88 per cent. The improvement of the record with the left hand, made after, compared with the one made before, the right hand practice, was 85 per cent. in time and 81 per cent. in errors, average 83 per cent. Another sub-

[1] Swift, *Mind in the Making*, 1908, Chap. VI., "The Psychology of Learning."

ject who made fifty tracings with the right hand showed an improvement of 82 per cent., and in the before and after tracings with the left hand 68 per cent. Ten laboratory students who made ten records each with the right hand improved on the average 53 per cent. In the before and after records, tracing with the left hand half of one outline each time, the average improvement was 49 per cent. Taking these results together they show that the left hand profits to the extent of 90 per cent. of the gain made by the right hand. From this, however a small amount must be subtracted which is due to the practice derived from the first left hand tracing." [1]

Other recently reported experiments are those by Wallin on the transfer of the effects of practice from one eye to the other and from the fovea to the peripheral retina. The closeness of the nervous connection between the parts used, the large number of similar nerve elements involved, and the evident effect of learning *how* to meet the requirements of the tests are sufficient to explain the results without recourse to Wallin's statement that "the doctrine of formal discipline, all but repudiated in this day of educational vandalism, is

[1] Starch, *Psychological Bulletin*, January, 1910, "A Demonstration of the Trial and Error Method in Learning."

still good pedagogical doctrine under certain limitations."

6. The following experiments were conducted by Thorndike and Woodworth at Columbia University:

"Individuals practiced estimating the areas of rectangles from 10 to 100 sq. cm. in size until a very marked improvement was attained. The improvement in accuracy for areas of the same size but of different shape due to this training was only 44 per cent. as great as that for areas of the same shape and size. For areas of the same shape but from 140-300 sq. cm. in size the improvement was 30 per cent. as great. For areas of different shape and from 140-400 sq. cm. in size the improvement was 52 per cent. as great.

"Training in estimating weights of from 40-120 grams resulted in only 39 per cent. as much improvement as in estimating weights from 120 to 1800 grams. Training in estimating lines from .5 to 1.5 inches long (resulting in a reduction of error to 25 per cent. of the initial amount) resulted in no improvement in the estimation of lines 6-12 inches long.

"Training in perceiving words containing e and s gave a certain amount of improvement in speed and accuracy in that special ability. In the ability

to perceive words containing i and t, s and p, c and a, e and r, a and n, l and o, misspelled words and A's, there was an improvement of only 39 per cent. as much as in the ability specially trained, and in accuracy of only 25 per cent. as much. Training in perceiving English verbs gave a reduction in time of nearly 21 per cent. and of omissions of 70 per cent. The ability to perceive other parts of speech showed a reduction in time of 3 per cent., but an *increase* in omissions of over 100 per cent." [1]

7. The following experiments were conducted by Squire and others at the Montana State Normal College:

"Careful experiments were undertaken to determine whether the habit of producing neat papers in arithmetic will function with reference to neat written work in other studies; the tests were confined to the intermediate grades. The results are almost startling in their failure to show the slightest improvement in language and spelling papers, although the improvement in the

[1] Thorndike, *Educational Psychology*, 1903 Ed., Chap. VIII., "The Influence of Special Forms of Training upon More General Abilities," p. 90. These experiments are described in detail in three articles in the *Psychological Review*, 1901, "The Influence of Improvement in one Mental Function upon the Efficiency of Other Functions." They have been criticised by Coover and Angell (F.), *American Journal of Psychology*, July, 1907, "General Practice Effect of Special Exercise," p. 308.

arithmetic papers was noticeable from the very first." [1]

8. The following experiments were carried out by Ruediger in the seventh grade of three schools to prove whether "the ideal of neatness, brought out in connection with, and applied in one subject, functions in other school subjects." The outline of the methods used in these experiments is too long to be quoted here. Neatness was emphasized in the written work, etc., of one subject, until the pupils showed decided improvement in that subject. The ideal of neatness was continually discussed by the teacher in connection with that one subject and with life generally, though no special allusion was made to the other school subjects. Then the written work in these other subjects, before and after the experiment, was compared to see whether the ideal of neatness had been carried over to them in such a way as to produce similar improvement in them. The results are summed up in the following paragraph:

"Evidently neatness made conscious as an ideal or aim in connection with only one school subject does function in other subjects. Directing our attention to groups [schools] I and III, the most

[1] Bagley, *Educative Process,* 1905, Chap. XIII., "Formal *versus* Intrinsic Values of Experience: The Doctrine of Formal Discipline," p. 208.

marked improvement of the papers occurred respectively in geography and in arithmetic, the subjects in which neatness was emphasized, but there was unquestionable improvement on the average also in other subjects. In group I the average grades [in neatness] in geography show an improvement of 5 points, and those in arithmetic and grammar respectively 4 and 3.4 points; while in group III arithmetic improved 4.5 points, and geography and history respectively 2.9 and 2 points. The number of pupils showing improvement is about the same in all the subjects. In group II the improvement was in no case very marked, but it is significant that the averages show nowhere any decline." [1]

9. The following experiment was conducted by Judd at Yale University:

"A person who was to be tested was seated in such a position that his right hand and arm were entirely hidden from view by a large screen. Whatever he did with this right hand would, therefore, be unseen by him. On the left side of the screen and in full view, nine different lines were shown in succession, and he was required to place a pencil held in the unseen right hand in the

[1] Ruediger, *Educational Review*, November, 1908, "The Indirect Improvement of Mental Functions through Ideals," p. 369.

direction indicated by the several lines seen before him. The errors made in placing the pencil were accurately measured and recorded. A standard of comparison was thus gained by which all later results could be valued. The next step in the experiment was to train the person being tested to more accurate localization of one special line, which for purposes of our description we may call No. 5. With this one line, No. 5, the reactor was given fuller visual experience and the error which he at first made with this line gradually disappeared. After this clear improvement with No. 5 the original conditions were restored, and the reactor was again tested as at first with all nine lines. Every line in the series was effected. This means that there had been a transfer of effects under the conditions of the training described.

"This, however, was not all. Some of the lines had shown in the first series of tests an error in the same direction as line No. 5; others showed an error in the opposite direction. The transfer of practice differed in the two kinds of cases in that those lines which had a like error with No. 5 improved with No. 5, while the lines which had errors in the opposite direction to No. 5 grew worse as a result of practice with No. 5. The

transfer of practice was no less real in the case of the lines which increased in error than in the case of the lines which improved. Both kinds of cases show that the functions involved are interdependent, and that transfer of practice is a complex process which must be studied from a variety of points of view if its different modes of operation are to be fully understood. Joint improvement is only one of the possible forms of transfer; reciprocal interference is just as significant a type of transfer as is joint improvement.

"The experiment was carried a step further. After practice with No. 5, a new practice series was instituted with another line, which we may designate as No. 2. It was found that the person being tested was now very much less affected by practice with No. 2 than he had been during the first practice series with No. 5. The amount of practice given with No. 2 was much greater in quantity and more radical in type, but the reactor remained relatively unaffected. This means, of course, that when the reactor first came to the experiment he was open to all kinds of suggestions. He was in the habit-forming attitude; he easily took on the effects of practice. But after the training which he received with the line No. 5, he was less capable of acquiring new adjustments;

he was no longer in the habit-forming attitude.

"This is a third phase of transfer of practice. It is no less significant than joint improvement or reciprocal interference, for surely any influence which renders an observer immune to the effects of new practice is not to be overlooked in discussing the relations of various forms of experience to each other. The closing up of possibilities of future practice is much more important a consequence of any practice series than the direct transfer of effects to other functions." [1]

10. Of the few experiments on the transfer of the effects of memory practice, two are described here in detail. But mention should be made in passing of the well-known experiments by James "to see whether a certain amount of daily training in learning poetry by heart will shorten the time it takes to learn an entirely different kind of poetry." James and four others tested themselves as to the time required to learn by heart parts of selected poems. Then, for varying periods of time, they practiced memorizing parts of other poems. No statement is made of the amount of improvement in this practice series. Then the experimenters returned to the first poems

[1] Judd, *Educational Review*, June, 1908, "The Relation of Special Training to General Intelligence," pp. 28-30. See other experiments outlined in same article and the general conclusions drawn from them.

—the test series—to test the improvement transferred by or from the practice series. The results showed very little improvement in the test series; and James concluded that whatever improvement there was consisted "in the improvement of one's habitual methods of recording facts." [1]

Mention should also be made of the experiments by Ebert and Meumann on the transfer of acquired ability in memorizing nonsense syllables, both after one and after two months of practice, to ability in memorizing other nonsense syllables, stanzas, prose sentences, numbers, letters, visual signs, etc. The considerable amount of transfer noticed in these experiments was probably due to the similarity of the material used in the different test and practice series, and to the development of better methods of memorizing, and, as Dearborn [2] suggests, to "direct practice in the test series, and not to any 'spread' of improvement from the practice series proper." The authors suggest, however, that there must have been some general ability developed by this specific training.[3]

[1] James, *Principles of Psychology,* 1890, Vol. I., pp. 666, 667.

[2] Dearborn, *Psychological Bulletin,* February, 1908, "The General Effects of Special Practice in Memory."

[3] Ebert and Meumann, *Archiv fur die Gesamte Psychologie,* IV. Band, 1. u. 2. Heft, 1904, pp. 1-232.

The following experiments were conducted by Winch with London school girls:—

I. "The first series of experiments was made with girls of the average age of 13 years. The first step was to divide the children into two groups of equal ability as to memory. This was done, partly on an actual test and partly on the opinion of the class teacher. The test set was a passage from a historical reading-book, which was not in the ordinary way accessible to children of this class. Ten minutes were allowed for memorizing; the work was mainly visual, articulation, however, being permitted, provided that it was not audible. The girls were then required to reproduce in writing as much as they could remember, fifteen minutes being allowed for this. One mark was allowed for each word rightly remembered and correctly placed. There were ninety-eight words in the exercise.

"With the aid of the teacher, the girls were now placed in two equal groups. The members of the A group, during the next week or two, were practised in learning poetry, the B group meanwhile working sums. With this exception, the school work of the two sections was the same during the progress of the experiment. After four practice exercises had been worked by group

A, the two groups were placed together and a final test given in history. The time allowed for each test and exercise and the method of marking were the same in all cases. The general result may be more clearly indicated by the following summary, showing the pupils arranged in sections according to the marks they obtained in the preliminary test in history and giving the average marks of the different sections in both the preliminary and the final history tests.

	GROUP A			GROUP B		
Marks in Preliminary Test	No. of Children	Preliminary Test	Final Test	No. of Children	Preliminary Test	Final Test
Full marks	3	98.0	133.0	2	98.0	131.0
95–98	5	96.4	130.6	7	96.0	121.1
90–95	4	91.5	123.2	3	91.0	111.6
80–90	2	82.0	113.5	2	85.0	92.0
Below 80	3	63.6	94.3	3	62.0	87.0

II. "A second series of experiments was made in another school, with girls of the average age of 13 years 3 months. The whole class, as in the previous school, was divided into two approximately equal groups, and one was practised in memory exercises, and the other not. The preliminary and final tests were, however, exercises in geography instead of history as in the

former school; and the poetical extracts given were simpler in meaning. Group B was occupied in writing whilst Group A was memorizing. The time allowed for memorizing and the method of marking were as before.

	GROUP A			GROUP B		
Marks in Preliminary Test	No. of Children	Preliminary Test	Final Test	No. of Children	Preliminary Test	Final Test
90 and over	3	90.3	98.6	3	90.3	95.0
85–90	6	88.0	92.0	6	88.2	93.1
75–85	5	80.0	94.6	5	80.4	85.2
Below 75	3	71.6	81.0	3	71.0	61.6

III. "A third series of experiments was carried out in the third school, with girls of the average age of 12 years 8 months. The general scheme of tests and exercises resembled that of the two previous experiments, history passages being used for the preliminary and the final tests.

	GROUP A			GROUP B		
Marks in Preliminary Test	No. of Children	Preliminary Test	Final Test	No. of Children	Preliminary Test	Final Test
98–108	7	103.8	104.6	7	102.6	100.6
68–98	8	84.5	77.3	8	82.5	64.3
48–68	8	58.3	64.0	7	58.8	46.7
0–48	4	28.5	64.7	5	27.4	41.6

"The conclusion from these three series of experiments seems definite and clear. Improvement, gained by practice in memorizing one subject of instruction, is transferred to memory work in other subjects whose nature is certainly diverse from that in which the improvement was gained.

"This, at least, is true as far as children of these ages and attainments are concerned. I expressly add this limitation as to age, for inferences from adult psychology to child psychology and to pedagogical practice are extremely unsafe, and I am anxious to avoid the opposite error." [1]

11. Fracker's experiments "on the transference of training in memory" are even wider in scope than those by Winch or by Ebert and Meumann. Only a brief account of them can be given here, in sentences selected from different parts of Fracker's monograph, with the essentials of the author's conclusions.

"The experiments given before and after training may be called the test series, and the other set, the training series. The test series is made up of several experiments, some of which are like the training series, while others differ. The object of these two sets of experiments is to discover what effect practice in the training set has upon the test

[1] Winch, *British Journal of Psychology*, January, 1908, "The Transfer of Improvement in Memory in School Children."

set in which the observer is not trained. This effect is measured by the difference in the results between the test series given before the training, and the test series given after the training. In order to measure the amount of training in the test series itself, two sets of observers are used: one set who take both the test and training experiments and another set who take the test experiments only. The difference in the gain between those trained and those untrained indicates the influence of the training experiments. The observers composing these two sets are selected on the basis of similarity in age and ability.

"The training series consisted in practice in memory for the order of four tones. The test series consisted of eight experiments, as follows: memory for poetry, for the order of four shades of gray, for the order of nine tones, for the order of nine shades of gray, for the order of four tones, for the order of nine geometrical figures, for the order of nine numbers, for the extent of arm movement.

"Each observer was asked to write a careful introspection at the close of each day's training, after each experiment of the test series, and a general introspection at the close of the experiments giving his observations and conclusions concerning the

essential elements in improvement and transference. At the beginning of each test, observers were given written instructions describing just what they were expected to do in response to the stimuli, but conveying no information as to how to do it. Results in both the test and the training series are estimated on the basis of the per cent. of correct responses."

Eight observers took both the tests and the training experiments, and four took the test experiments only. All observers had had some training in psychology. The first group of observers made an average of 21 per cent. in the training series and the following gains in the test experiments: four grays 36, nine tones 22, nine grays 19, four tones 10, geometrical figures 13, nine numbers 4, movement 0, poetry 7. The second group of observers (untrained) made the following average gains in the test experiments: four grays 4, nine tones 11, nine grays 10, four tones — 2 (loss), geometrical figures 8, nine numbers 0, movement — 1 (loss), poetry 2. The difference between the gain of the two groups, which "indicates the influence of the training experiments," was as follows: four grays 32, nine tones 10, nine grays 9, four tones 12, geometrical figures 5, nine numbers 4, movement 1, poetry 5.

"Three significant features are noted in the above table; first, the difference between the improvement of the trained over the untrained; second, the difference in the improvement in the tests similar to the training series in trained observers over their improvement in tests dissimilar; and third, the greater amount of improvement in the tests than in the training."

"The central or most essential element in *improvement and transference* is individual imagery. Improvement seems to depend upon the consistent use of some form of imagery, whether it is the most advantageous form or not. Imagery may be sub-consciously developed, but if it comes to be consciously recognized, the improvement is more rapid. The rate of improvement seems to depend directly upon the conscious recognition of the imagery, and upon attention to its use. A change of imagery during practice increases the rapidity of the improvement if a better form is adopted and adhered to. It may prevent improvement if a change of imagery is frequent, or if a less adequate form is adopted. Individual differences are clearly shown in different types of imagery by the rapidity with which the imagery develops, and by the clearness or definiteness of the imagery. The habit of guessing interferes with the formation of

imagery and, therefore, results in lack of improvement."

"When the acts are made up of quite different elements, there is a distinct breaking up of the habit of responding, by the intrusion of different elements, which raises the whole act into active consciousness so that the transfer of elements from one act to another act, other than the identical ones, is a conscious transference. It seems, therefore, that a conscious effort to use the elements of training in a different task assists in making the transfer." "If, in the mind of the observer, the imagery is capable of adjustment to different tasks, it can be used in both improvement and transference, for the elements of the training act are thereby made the same as those of the test act." [1]

12. The following experiment was conducted at the Speyer School, Teachers College, with sixteen children of about eleven years old. The purpose was to test the effect of acquired ability to discriminate between shades of blue upon the ability to discriminate between shades of red, of yellow and green, and black and orange. The great transfer of ability shown by the experiment was probably proportionate to the similarity between

[1] Fracker, *Psychological Review Monographs,* 1908, Vol. IX., No. 38, University of Iowa Studies in Psychology, No. 5, "On the Transference of Training in Memory."

the test with blue and those with the other colors. The amount of error was calculated according to the grade of difference between the two shades used in each experiment, which the children failed to recognize. The results are given in averages, before and after the training with shades of blue.[1]

Tests with red and white.

Boys.	Before	4.5	4.5	3.0	3.2	2.3
	After	.6	.7	.9		
Girls.	Before	3.5	6.0	4.2	3.4	2.4
	After	.48	.75	.65		

Tests with yellow and green.

Boys.	Before	6.7	5.3	4.0		
	After	2.0	2.0	1.3	3.0	
Girls.	Before	5.0	5.2	5.0	5.1	
	After	2.8	2.6	1.7	1.7	2.1

Tests with black and orange.

Boys.	Before	3.0	2.8	3.4		
	After	1.2	1.6	.8	.9	1.0
Girls.	Before	2.7	2.7	2.2		
	After	1.8	1.3	.9	.5	.5[1]

[1] Bennett, *Formal Discipline*, 1907, Columbia University. See other experiments reported in this thesis.

13. The following experiment was conducted by Coover and Angell:

"Four reagents were trained in discrimination of intensities of sound for 17 days during an interval of 57. Each reagent made 40 judgments in each day's training.

"Before and after training the reagents were tested in the discrimination of shades of gray, each test consisting of three series, each containing 35 judgments, delivered on 3 separate days. . . . . .

"All the test reagents with one exception show a gain in Right and loss in Undecided judgments after training. . . . . The per cent. of gain for the 4 test reagents was 4, 4, 6, 6, 0, 0, and 27, 5, making an average of 9, 1. . . . . .

"Improvement seems to consist of divesting the essential process of the unessential factors, freeing judgments from illusions, to which the unnecessary and often fantastic imagery gives rise, and of obtaining a uniform state of attention which is less than a maximum. . . . . .

"Our conclusion from the experiment, therefore, is that efficiency of sensible discrimination acquired by training with sound stimuli has been transferred to the efficiency of discriminating brightness stimuli, and that the factors in this

transfer are due in great part to habituation and to a more economic adaptation of attention, *i. e.*, are general rather than specific in character." [1]

14. The following experiments were conducted by the Dartmouth Pedagogical Department, under the direction of Lewis:

"First, two test papers were prepared, one containing originals in geometry and the other questions in practical reasoning." The papers are given in the article from which these extracts are taken. Three questions were given in each paper. The second paper dealt with the value of high school education to the individual and to the community. "These tests were submitted to twenty-four different groups of high-school pupils. The students of each group belonged to the same class and were on an equality with respect to mathematical preparation. Each group took both tests. The results of these tests were carefully corrected and the pupils of each group arranged in two series, the first according to their ranking in mathematical and the second according to their ranking in practical reasoning.

"If we take the first five mathematical reasoners

[1] Coover and Angell (F.), *American Journal of Psychology,* July, 1907, "General Practice Effect of Special Exercise." See also the description of their inconclusive experiment on card-sorting and typewriter reactions.

from each of the twenty-four groups, we have in all one hundred and twenty pupils most excellent in mathematical reasoning. Of this number seventy-six, or 63 per cent., are at the foot of the practical reasoning series, conspicuous for their inefficiency in practical reasoning. Of the number of pupils at the foot of the mathematical reasoning series, fifty-seven, or 47 per cent., are conspicuous for their positions at the head of the practical reasoning series.

"As a supplementary test, and one precisely the same in principle, one man examined the records of Dartmouth students who had taken mathematics and certain law courses which required a good deal of reasoning. The records for ten different classes were examined, and tables were formed as in the previous test.

"The results of this test were found to be strikingly parallel to those of the earlier test. Fifty per cent. of the best students in law were conspicuous for their poor showing in mathematics; and 42 per cent. of those poorest in law stood at the head of the series in mathematics." [1]

15. The value of the Dartmouth conclusions

[1] Lewis, *School Review,* April, 1905, "A Study in Formal Discipline," pp. 289-291. For criticism of these conclusions, with some indefinite studies of correlation between ability in mathematics and ability in other subjects, see Collins, *School Review,* October, 1906, p. 607.

has been challenged by Rietz and Shade, as the result of a recent statistical investigation made by them at the University of Illinois. The reader is referred to their pamphlet for explanation of their methods.[1] Coefficients of correlation were computed for the grades of several hundred students in mathematics, foreign languages, and elementary science (chemistry, botany, and geology). The conclusions of this investigation are stated in the following coefficients of correlation, with their probable errors: for mathematics and foreign languages, r=0.476—0.015 or +0.015; for mathematics and natural science, r=0.440—0.015 or +0.015. "Two characters are said to be correlated if to a selected series of sizes of the one, there correspond sizes of the other whose mean values are functions of the selected values." "The probable error in any result may be defined as that deviation from the determined value, on either side, such that it is an even wager that the true value lies within this amount of the determined value." Although the coefficients of correlation are surprisingly small, the authors claim to be "justified in saying that efficiency in mathematics and efficiency in foreign languages go to-

[1] Rietz and Shade, *Correlation of Efficiency in Mathematics and Efficiency in Other Subjects,* 1908, University of Illinois.

gether in general to a high degree, and that to substantially the same extent do efficiency in mathematics and in natural sciences go together."

As this investigation is typical of others, it deserves further discussion. Even if the above coefficients of correlation were considerably greater than they are, we do not believe that they would give strength to the doctrine of formal discipline (as the authors would have us believe), because they do not prove that the ability derived from the study of mathematics is transferred to and thereby increases the abilities derived from the study of foreign languages or natural science, or *vice versa.* The way to prove the transfer of acquired ability from one subject to another is (1) to measure the ability in each subject at the beginning of the test, (2) to concentrate on increasing the ability in one of the subjects, and then (3) to measure again the ability in the other subject to see if there has been any increase following the increase made in the subject concentrated upon. The investigations by Rietz and Shade do not meet any of these requirements. In the first place, there is no test, comparative or otherwise, of increase of ability in the given subjects. It must also be remembered that most, though not all, of the courses were taken simultaneously, not suc-

cessively. In the second place, there is not the slightest proof that the marks in the different subjects had any relation of cause or effect to each other. A student might have received exactly the same marks in two subjects without there having been any relation of cause or effect between them. In the third place, the pamphlet states that there had been secondary school training in the different subjects or in allied subjects. This specific preparation in each of the subjects, based upon the native ability or lack of ability of the student, was sufficient to account for the correlation of the marks in the given subjects, without any transfer of ability from one to the other. But if there really were any transfer, it could easily be explained by the common elements of the given subjects. We conclude, therefore, that this investigation and others like it may invalidate the extremes of the Dartmouth results but that they have little or no value as a support to the doctrine of formal discipline.

Similar investigations on the correlation of abilities furnish proof *against* the doctrine of formal discipline by showing greater differences between abilities, even between those that seem very much alike, than the doctrine would lead us to expect. "For instance, the correlation in adults between

(1) memory for figures and (2) memory for unrelated words (memory being used to mean the power to keep a list in mind, after once hearing it, long enough to write it down) is not over .8; the correlation of pupils in the highest grammar grades between (1) quickness in thinking of the opposites of words and of the letters preceding given letters of the alphabet and (2) quickness in thinking of the sums of figures is not over .7. Yet the first pair of tests would commonly be used indiscriminately as tests of 'memory,' and the second pair as tests of 'association,' upon the supposition that the two members of each pair were practically identical traits. Even so apparently trivial a difference as that between drawing a line to equal a 100 mm. line and drawing a line to equal a 50 mm. line causes a reduction from perfect correlation. The resemblance is, for 37 young women students, only .77." [1]

Although a small amount of correlation necessarily shows that there has been little transfer of ability, even a large amount of correlation does not necessarily show that there has been great transfer of ability. In the latter case, proof must

[1] Thorndike, *Educational Psychology,* 1910 Ed., Chap. IX., "The Relations between the Amounts of Different Traits in the Same Individual." For further studies and references on the subject of correlation, see Whipple, *Manual of Mental and Physical Tests,* 1910, "Correlation" in Index.

be shown that the increased correlation is due to this transfer and not to native ability or to acquired ability in both subjects. The burden of proof rests upon those who have a positive correlation to explain, but a negative correlation is sufficient proof in itself of the absence of transferred ability. "Finding correlation between two functions need not mean that improvement in one has brought about increased efficiency in the other. But the absence of correlation does mean the opposite." (Thorndike and Woodworth.)[1]

On the basis of some studies in correlation between accuracy of London school children in numerical computation and accuracy in arithmetical reasoning, Winch comes to the following conclusion: "It seems to be possible to find highly correlated functions which appear to have very little relationship with pedagogical value. We cannot conclude, without further inquiry on other lines, that two highly correlated mental powers are causally related. If they have a common factor or a common cause, it may be one which our methods cannot influence, and its determination has then little value for practical di-

[1] Thorndike and Woodworth, *Psychological Review*, May, 1901, "The Influence of Improvement in One Mental Function Upon the Efficiency of Other Functions," p. 248.

rection, except in a negative sense. Two quantities may be highly correlated but their ratios of growth may not be; nor may we be able to produce increase in the one by producing increase in the other. I understand that these empirical conclusions are quite in accord with correlational theory, but it is well to state them here, as it is quite possible that educationists will regard an established high correlation as justifying several inferences which do not properly flow from it." [1]

16. The following experiments with school children were conducted by Norsworthy to test the amount of correlation between selected functions:

"Tests were given in multiplication, in observing misspelled words, in marking words containing *e* and *r*, in observing the word *"boy"* wherever it occurred, and in marking semi-circles scattered amongst all sorts of geometrical forms. Differences of the same individual had been measured in arithmetic, spelling, and in ability to mark certain forms. One of them was taken as a standard and the other tests correlated with it.

"The conclusions reached from this study are in line with those already quoted, namely, that it

[1] Winch, *Journal of Educational Psychology*, December, 1910, "Accuracy in School Children. Does Improvement in Numerical Accuracy 'Transfer'?" p. 587.

seems probable that certain functions which are of importance in school work, such as quickness in arithmetic, accuracy in spelling, attention to forms, etc., are highly specialized and not secondary results of some general function..... Accuracy in spelling is independent of accuracy in multiplication, and quickness in arithmetic is not found with quickness in marking misspelled words; ability to pick out the word boy on a printed page is no guarantee that the child will be able to pick out a geometrical form with as great ease and accuracy." [1]

17. The following experiment was conducted by Stone to determine the arithmetical abilities of the sixth-grade pupils in twenty-six schools. The pupils were given under similar conditions the same problems in "fundamentals" (addition, subtraction, multiplication, division) and in "reasoning" (practical application of the fundamental operations). The results showed marked variation of pupils in (1) ability in fundamentals as compared with ability in reasoning and (2) ability in any one of the four fundamentals as compared with any of the other three. These variations are shown by the coeffi-

[1] Norsworthy, *New York Teachers' Monographs,* December, 1902, "Formal Training," pp. 98, 99.

cients of correlation between these abilities. The author concludes that "the net result of the arithmetic work of the first six years is *several products* rather than *a product*. The study of arithmetic makes demands on a plurality of abilities. Hence it is inaccurate to speak of the arithmetical ability of pupils, and it is bad educational practice to treat the subject as though it were a unity instead of a plurality." [1] As the author suggests, such a conclusion antagonizes the doctrine of formal discipline because it disproves the complete transfer of abilities from one phase of the same study to another. Even within the limits of the same study there are variations in abilities, according to the nature of the different activities involved in the study; even within the limits of the same study there is a decrease in the transfer of abilities, proportionate to the difference in the activities involved in the study.

18. The following experiments were conducted under the supervision of Winch in three London municipal schools for girls and one school for boys. The purpose of the experiments was to seek an answer to the question, "Does improvement in accuracy of numerical computation 'transfer' to arithmetical reasoning?"

[1] Stone, *Arithmetical Abilities*, 1908, Teachers College, p. 43.

"The general method adopted was the same throughout, though there were minor modifications as to the number and difficulty of the exercises in different schools. In each case a whole class, working according to the same syllabus of work and under one teacher, was divided into two equal groups. The division was effected on the results of several tests in problematical arithmetic. In order that the natural ability of the children rather than their memory of recent teaching should be tested in these exercises, it was arranged that no problems should be given in a form with which the pupils were well acquainted. The tests were marked solely with reference to the accuracy of the arithmetical reasoning and entirely without reference to the accuracy of the numerical computation. No attention was paid to the *right answers;* marks were given with reference to the process only.

"When the two equal groups had been obtained, one of them was practised in a series of exercises in 'rule' sums which every child knew how to do; the other group being meanwhile engaged in some other branch of school work. In every other respect the curriculum for both groups was precisely the same during the period of the experiment. I need, perhaps, hardly say that no

other arithmetical work was done during the time the experiment lasted.

"Finally the two groups, namely, the one practised in accurate numerical computation and the one not so practised, were placed together again, and final tests were given in arithmetical reasoning. There had been, in all cases, a considerable improvement in the accuracy of numerical computation during the series of practice exercises. How far was this improvement of accuracy in arithmetical computation transferred to accuracy in arithmetical reasoning? Did the practised or non-practised groups do better work when the groups worked the same test exercises at the end?"

"The following tables summarize the results for the four schools:

School "S"

Marks in Preliminary Exercises	NON-PRACTISED GROUP A			PRACTISED GROUP B		
	No. of Children	Av. Mark per Child in Preliminary Exercises	Av. Mark Final Exercise	No. of Children	Av. Mark Per Child in Preliminary Exercises	Av. Mark Final Exercise
30 and over	1	33.0	15.0	1	32.0	16.0
25 to 30	5	27.4	14.6	4	28.7	13.5
20 to 25	2	20.5	7.5	3	22.0	7.0
15 to 20	4	18.0	9.2	4	18.0	9.2
10 to 15	4	14.2	6.0	4	14.0	4.2

School "B"

Marks in Preliminary Exercises	NON-PRACTISED GROUP A			PRACTISED GROUP B		
	No. of Children	Av. Mark Per Child in Preliminary Exercises	Av. Mark Final Exercise	No. of Children	Av. Mark Per Child in Preliminary Exercises	Av. Mark Final Exercise
Over 35	2	37.0	33.5	2	36.0	35.0
35 to 30	2	32.5	32.0	3	32.7	32.7
30 to 25	5	29.0	28.8	4	28.7	28.0
25 to 20	3	24.0	23.3	4	22.5	27.7
20 to 15	5	18.6	18.8	4	17.5	16.0
15 to 5	5	9.0	12.2	5	9.8	15.4

School "I"

19	4	6.3	7.5	5	6.3	7.1
18, 17, 16	7	5.6	6.4	6	5.5	7.7
15, 14, 13, 12, 11	4	4.5	4.8	5	4.3	5.2
6, 5, 4	4	1.9	1.2	3	1.6	1.6

School "O. K."

35 to 40	4	37.8	38.3	4	37.8	38.8
30 to 35	3	34.0	38.7	3	34.0	37.0
25 to 30	6	28.0	28.2	5	28.0	32.8
20 to 25	4	22.8	23.8	5	22.6	28.6
15 to 20	8	17.8	19.5	8	17.5	20.3
10 to 15	5	13.2	18.8	4	12.0	13.8
5 to 10	5	8.4	8.6	4	7.8	13.3

"It seems possible to improve the accuracy of numerical computation *without any certainty* that we shall thereby improve the accuracy of arithmetical reasoning.

"For the present, therefore, pending more conclusive experiments, numerical accuracy should be sought for because it is valuable in actual life, and not because we can feel confident that an improvement in it will transfer to accuracy of arithmetical reasoning.

"But if improvement in accuracy of numerical computation is not transferred, how shall we account for the general trend of the final results in reasoning (in all schools except "S") in favor of the practised groups?

"There seem to me two possibilities. I have judged the children's reasoning powers in arithmetic by problems numerically worked out, though the accuracy or inaccuracy of the numerical solution has not affected the mark for reasoning. Might not the greater facility in numerical computation, such as was obtained by most of the practised groups, set free, as it were, more mental energy to deal with the rational solution of the problems?

"Also, since, in school, the functions of numerical computation and of arithmetical reasoning are

often exercised together, the continuance of numerical computation by one of the groups and its discontinuance by the other might well maintain in one case a greater readiness for the associated operations than in the other, and the former would on that account do better work in arithmetical reasoning than the latter.

"But if either of these hypotheses were true, ought we not to expect more regular results; though not perhaps such regular results as if there were a direct transfer of accuracy?" [1]

19. Ruger has made some valuable confirmations of the theory of specific disciplines and of the possibilities of transfer through "ideals of method" in his "experimental study of the processes involved in the solution of mechanical puzzles and in the acquisition of skill in their manipulation." As these experiments bear so closely upon our problem, considerable space must be given to them in our summary.

"Mechanical puzzles were chosen as the material to be employed. The term mechanical is used to indicate that all the puzzles involved actual manipulation of the materials. No trick puzzles were used, *i. e.*, all the puzzles were possible of solution

[1] Winch, *Journal of Educational Psychology*, December, 1910, "Accuracy in School Children. Does Improvement in Numerical Accuracy 'Transfer'?"

and all the physical materials required were supplied to the subject. The puzzles might be roughly classified into analytical and synthetical, and, again, into tridimensional and bidimensional. Most of the puzzles were analytical and tridimensional. They were for the most part made of wire, and involved the removing of some part of the apparatus, such as a ring, star or heart, from the rest. Some of the puzzles were of the synthetic or construction type, such as the familiar jigsaw puzzles or rarer forms involving three dimensions. The movements required for solution were, in general, rather complex. In certain cases the degree of complexity could be indefinitely increased, and yet a single rule be developed for solution in the various resulting forms."

"The method of conducting the experiments was very simple. The subject was seated comfortably at a table, on which the puzzle was placed. The puzzle was covered by a screen. After the warning signal a starting signal was given, and the screen removed. When the manipulation for the given trial had been completed, the puzzle was immediately removed by the operator and prepared for the following trial. The subject was given no opportunity to examine the puzzle except during the actual trial. The number of trials for a given

subject for a given puzzle varied from 1 to 1,440. The standard number was 50. Fifty-one series were taken in which the number of trials composing the series equaled or exceeded 50. The number of trials at a given sitting varied with the subject and the puzzle. The sittings were usually of an hour and a half in length. In some cases an entire series of 50 trials was completed in this interval. In others several periods were consumed in gaining the first solution."

"All except five of the subjects had done work in psychology and had some special interest in it. .....Five of the subjects were women..... There were, altogether, twenty-seven subjects. Nine of them completed long series on at least six puzzles each. The remainder were given fewer puzzles and shorter series."

The experiments and discussion on transfer are given here at length. The author says that "the term, transfer, is used rather broadly to include both the specific and general effects of a given experience on succeeding experiences.

"a. *Specific Motor Habits.*—(1) A given subject was tested with a puzzle thrown in chance positions. He was then trained to approximately the physiological limit in handling four special but important positions. He developed no general

rule to include his treatment of these special positions. He was then retested with the puzzle in chance positions. Another subject was trained entirely with chance positions, in a series approximately half the length of the first subject's series. The second tests of the first subject showed no improvement over the initial results and were inferior to those of the second subject. This failure to profit by the highly specialized training seems to have been due to the lack of a generalized rule of procedure. As it was, each chance position was first reduced to one of the four special positions and then the solution was proceeded with instead of being performed directly.

"(2) A certain puzzle was so arranged that it could be presented in various forms. The manipulations for these various forms could all be comprised under a single formula. This general formula could be deduced from any one of these special forms. A number of subjects were tried with this puzzle. As soon as skill was acquired in dealing with one form of the puzzle it was changed to another form. The subjects who developed the general formula during the solution of the first form were able to use the specialized habits built up in the first form in the second. Those who formed merely the special habits with-

out developing the principle, attempted to carry over the habits without modification and were greatly embarrassed by the change.

"(3) A subject was tested with a puzzle in a given form. Then all the motor habits necessary for the rapid solution of this form were built up by practice on the separate acts of manipulation involved. The elements were organically related in the successive forms of the practice series, so that the practice was not on the separate elements merely but on their connections. At the close of the practice series the subject was given the complete form, which was identical with that of the initial test. This form was not recognized as being related to the practice series, and the habits built up there were not brought into use.

"In general, the value of specific habits under a change of conditions depended directly on the presence of a general idea which would serve for their control.

"b. *Concrete Imagery.* The mere presence of imagery, although vivid and of closely related puzzles, was no guarantee of its efficiency. Very often attention rested on some superficial point of similarity and progress toward solution seemed to be delayed instead of hastened. The value of the

image as well as of the motor habit depended on the precision of the analysis.

"c. *Attitudes and Attention.* As has been previously stated, the first success often brought a complete change of attitude toward the puzzles. This transfer or extension of mood seemed at times to be almost reflexly accomplished, so direct did it appear. A change in the subject's idea of himself, from that of one incapable of solving such a problem to one capable of doing so, probably played a part in the change of mood. A similar but less decided change of mood was at times accomplished, in the absence of success, by the suggestion that the subject was doing as well as others. An attitude of self-confidence was at times self-induced through an idea of its value, and subjects were able by this means to avoid a state of confusion when in difficulty, to which state they had previously fallen victims.

"No evidence was secured in favor of an automatic change in level of attention, but there were indications of its indirect control by means of ideals of what constituted an efficient state of attention.

"d. *Ideals of Method.* The great significance of ideals of method has perhaps been sufficiently

emphasized. This significance was especially striking in proportion as the situation in question was distinctly novel. The idea of efficiency as a goal to be reached, the ideals of scientific method, and the deal of an optimum personal attitude were among the most important of these." [1]

20a. Scott experimented with a group of twenty students to test their comparative suggestibility as to color and as to heat. He found such differences between the tests that he was led to the following conclusion, for which his tests do not seem to give a sufficiently wide basis.

"At all events the inference from a study of these two experiments (and others not here described) is that degrees of suggestibility as determined from one test cannot be inferred as holding for suggestibility in general. Before individual A can be said to be more suggestible than individual B they must have been subjected to many and diverse forms of tests. Otherwise different degrees of suggestibility should be affirmed as present only for the particular form or forms as tested." [2]

b. Whipple made two sets of experiments to determine the "effect of practice upon the range

[1] Ruger, *Psychology of Efficiency*, 1910, Archives of Psychology, No. 15. In Chap. VI, Ruger gives a detailed analysis of these experiments and a further explanation of the results.

[2] Scott, *Psychological Review*, March, 1910, "Personal Differences in Suggestibility."

of visual attention and of visual apprehension." "In the first set of experiments (range of attention), 5, 6 and 7-place series of isolated letters were exposed for 0.08 sec. with a tachistoscope. The observers were six college students. . . . . In the second set of experiments (range of apprehension), groups of dots, pictures, drawings, nonsense syllables, and stanzas of poetry were exposed for 3 sec. with the tachistoscope, and collocations of 10 objects were exposed without instrumental aid for 6 sec. The observers were three adults." The author concludes that the effect of the practice was specific in both sets of experiments.[1]

c. Foster made similar experiments to test the "effect of practice upon visualizing and upon the reproduction of visual impressions." "Real objects, pictures, and nonsense-drawings were shown to three observers for moderate times (10 to 60 sec.). Exact reproduction by drawing, sometimes supplemented by written description, was then required." The observers were advanced students of psychology. The author concludes that his "results show that the ability gained is very specific."[2]

[1] Whipple, *Journal of Educational Psychology*, May, 1910, "The Effect of Practice Upon the Range of Visual Attention and of Visual Apprehension."

[1] Foster, *Journal of Educational Psychology*, January, 1911, "The Effect of Practice Upon Visualizing and Upon the Reproduction of Visual Impressions."

CHAPTER IV

OBSERVATIONS

The following observations are those which seem to us to militate most strongly against the doctrine of formal discipline. Though based upon general experience rather than upon laboratory experiments, we believe that these observations are strengthened by the results of the experiments on transfer.

1. The training of one part of the body results in a specialized development of that part, rather than of other parts or of the body as a whole, except in so far as a generally increased circulation and metabolism increase the vigor of the whole organism. The way to train a particular muscle or organ is through the proper exercise of that muscle or organ rather than of others. In so far as related muscles or organs are involved in the same training exercises, they will also be trained by these exercises. But muscles or organs cannot be trained unless they or the nerve centres controlling them have in whole or part under-

gone exercise and training. Each one of us is more capable in those parts of the body that have been better trained in the course of our lives. And even these parts act better for some special purposes than for others, because they have been trained to act in these specific ways.

2. The training of the mind in regard to one subject results in a specialized ability to deal with this subject, rather than with other subjects. In so far as other subjects are similar in matter or in method to the first subject, the mental ability to deal with this first subject can be used with the other subjects. But ability to deal with any subject cannot be developed unless the mind has been exercised directly with it or indirectly on account of some of its elements being included in the other subjects with which the mind has been directly exercised. Furthermore, from the standpoint of psychophysics, mental exercise in connection with any part of the brain will tend to increase the circulation and metabolism in the brain as a whole, just as physical exercise in any part of the body will tend to increase the circulation and metabolism in the body as a whole; but this generally increased vitality is far different from the specialized ability acquired through specific training.

3. Most of us recognize that we are special-

ized in our mental abilities, showing more accuracy, concentration, reasoning, endurance, etc. in dealing with those matters with which we have had most to do. We know from experience that we cannot transfer these abilities to other matters without loss. We think better about some particular things than others, we feel more keenly about some particular things than others, we do more easily some particular things than others. In many cases it is easy for us to trace out those past experiences that have produced these specialized abilities; and on the other hand we can justify our lack of ability in other lines by showing how little opportunity we have had to develop these other specialized abilities. We are more or less a bundle of specific abilities and of specific inabilities, doomed to our efficiencies and our inefficiencies by the activities which have made out of our native tendencies whatever we are to-day.

4. We also notice in those about us a similar particularization of ability to lines of activity which have become habitual. We notice this most strikingly in the narrow abilities of many specialists (doctor, merchant, housekeeper, etc.), who appear at an increasing disadvantage the further they digress into fields dissimilar to their own.

5. The business and professional world relies

more and more on the superiority of specialized ability resulting from special training. Men are thereby becoming more efficient specialized workers but less adaptable, less transferable, more dependent upon the specialized demand for their work. Thus is being produced an economic dependence which is almost fatalistic. The way to overcome this fatalism of specialization is not by claiming the transfer of acquired ability, a dogma that the employer and the public will not accept as a wise business principle. Either the ability of the specialist must be related in matter or in method to other abilities (and this is not often the case at present), or the specialist must be trained in the broader activities, if not in the details, of two or more specialties. This is one of the arguments for manual training courses as preparation for industrial work of any kind. It is no exaggeration to say that the necessities of economic competition have shown the fallacy of the doctrine of formal discipline.

6. The ability displayed by some people in two or more lines of activity may be due to their having been specially trained in these lines and not to a transfer of acquired ability from one activity to another. Or the activities may be so closely related that ability in one is in part ability in the

other. Or these several abilities may be due to the general native ability of the person, resulting from the innate structure and vitality of the brain. There is often a failure to distinguish in thought between native ability, which is either general or special, and acquired ability, which is special. The former is due to the superior nature of the brain, in whole or in part; the latter is due to the action of stimuli upon a specific part of the brain, according to the nature of the stimuli as well as of the brain. No one doubts that some people have unusual native capacity for receiving and holding impressions, for sustaining close attention, for making clear judgments, for exercising vigorous and precise muscular control, etc. A person may thus be talented in one or in several lines. His initial superiorities will render more efficient and rapid his development in one line of activity or in several; but, in the latter case, the development in a subsequent line of activity is not due to a previous development in a different line of activity, but to a singular native superiority of intra- or inter-cellular organization or metabolism in the different parts of the brain connected with the different lines of activity. The ability of school pupils in several studies is often used to support the belief in the transfer of acquired

ability from one subject to different subjects, whereas no such explanation seems needed or justifiable in these cases.

7. Furthermore, the ability of pupils in one study after they have acquired ability in another study may be due to general growth processes at that period of physical and mental development, regardless of particular studies and acquired abilities. The different stages in the growth of a child represent the birth of new tendencies, interests, and abilities, which greatly affect his school work. This is often seen in high-school pupils, whose general adolescent development of secondary sex characters and of the association centres of the brain will largely account for their increased ability in successive studies of different kinds. These factors of constitutional growth are generally overlooked, not only in the curricula and methods used at different stages of growth, but also in our explanations of the progress made in school work at these different stages.

8. The variations shown by the same pupils in their class standing in different studies are puzzling to the formal disciplinists. These variations may be due to differences in application, in native ability, or in acquired ability for this or that particular work. In so far as they are due

to acquired ability, the doctrine of transference does not seem to hold, for the abilities acquired in one study do not spread uniformly to other studies. The greater amount of uniformity often noticed in the class standing in related studies seems to show that in so far as studies are similar there tends to be a similar ranking of the pupils in these studies.

9. But what is more serious is the generally recognized fact that pupils who excel in school are often beaten in professional or business life by fellow-pupils who ranked below them in class standing. The school abilities acquired through school activities are not in these cases carried over to the environmental activities outside the school. This is due to the difference between the matter and the method of the two activities and to the consequent inability of the pupils to make success in the one issue into success in the other. If there were such a transfer of acquired ability as the doctrine of formal discipline implies, there would not be such a difference in the ranking of individuals in the two activities.

10. Closely related to a recognition of this fact is the popular demand for more "practical" courses in the schools. This demand is based upon a belief, not only that the kind of training

derived from these courses is different from that derived from others, but that this kind of training is the one needed for practical efficiency, because it is derived from materials and methods similar to those used in practical life. The doctrine of democracy in education and the doctrine of formal discipline cannot be well harmonized. When only the favored few "took" education, the doctrine could be cherished as a cultural ideal and the waste involved in its application could be overlooked or tolerated without economic hardship. But when the masses of limited means determined to educate their children, they questioned some of the school's circuitous methods of promoting mental development and exerted their power to eliminate indirect and wasteful ineffectiveness in preparing boys and girls as soon as possible for independent service. This is one of the reasons why the doctrine of formal discipline is retiring from the elementary schools and is showing signs of increasing discomfort in the secondary schools, as the latter become democratic in sympathy and usefulness as they have become democratic in support and control.

11. Finally, we notice that adherents of the doctrine of formal discipline shrink from carrying their doctrine to its logical conclusions, namely,

the exact equivalents of studies for mental discipline or, if a distinction is made between them, the concentration on a single superior study for the training of a given power or set of powers. In practice, if not in theory, these adherents acknowledge a variation in training of a given power or set of powers as related to a variation in content of study. A case in point is the inconsistency of the Committee of Ten on Secondary School Studies in stating what seems to be a belief in the equivalence of studies and then specifying elaborately varied curricula, representing different phases of the environment, different subject-matter and method. Baker dissents from the doctrine of equivalence in his minority report. Schurman seconds him in a magazine review, declaring that "the Committee of Ten, and some of the conferences as well, have fallen victim to that popular psychology which defines education merely as the training of the mental faculties." [1] Taylor, a member of the Committee, replies in an article of defence that the word "equivalence" was used "in relation to college requirement. The thought of the committee was surely equivalence of results, in this aspect, rather than equivalence of value, intrin-

[1] Schurman, *School Review*, February, 1894, p. 93.

sically considered." [1] This is not exactly the point at issue. Are studies equivalent for mental discipline, even though we recognize their difference "of value, intrinsically considered"? The practical influence of the Committee's report has been to strengthen the current belief in this disciplinary equivalence, though the Committee's real intention is better shown by its suggestive curricula.

[1] Taylor, *School Review*, April, 1894, p. 196.

CHAPTER V

LOCALIZATION OF FUNCTION

A strong theoretical objection to the doctrine of formal discipline is implied in the generally accepted theories of localization of function to special areas of the cerebral cortex (visual, auditory, motor, association, etc.), of the division of the motor area into sub-areas (leg, hand, face, etc.), and of the division of the sub-areas into very small areas representing movements (opening of eyes, closing of eyes, opening of mouth, protrusion of tongue, etc.). It seems reasonable to draw from these theories the hypothesis, which seems to us consistent with the results of the experiments on transfer, that for every specific function there is a concomitant stimulus of specific parts of the cerebral cortex and their specific connections with other parts of the central nervous system. Of course, it is recognized that neural activity is not absolutely limited to these parts in concomitance with a specific function; but it is held that neural

activity centers in these parts in concomitance with the specific function. It would follow then that, as every stimulus modifies the specific parts in such a way as to make the succeeding stimulations of them easier (the law of habit formation), a succession of similar functions synchronizes with a succession of stimulations of specific parts of the central nervous system, which so modify these parts as to produce the physiological counterpart of a specific acquired ability. If, in the course of time, the acquired ability becomes so great as to require little or no conscious control in its functioning and to approach the automatism of a habit, its specific limitations become more and more decided, because the habit becomes more and more difficult to modify in other directions. Acquired abilities and habits are specific on account of their bases in localized and specific modifications of the central nervous system. As was previously suggested in discussing the experiments upon cross-education, activities which are in part controlled through different centres in the cerebral cortex may also be in part controlled by the same centres in the other parts of the central nervous system. The only way to get the benefit of previous training is through a use of the modified parts, all or some, in former associations or in new associations.

The extent of the benefit derived is proportionate to the number of these parts used and to the extent of the previous modification of them. However, if effort is made to use these previously modified parts in different ways in different associations, the tendency of the stimulation of these parts to issue into activity in the previous way and association may interfere with the latter activity. This interference will be proportionate to the difference and the comparative strength of the two associations.[1]

The doctrine of formal discipline, on the other hand, seems to imply that the modifications produced by successive similar stimulations and activities are not localized in specific parts of the central nervous system but are distributed to many different parts and can be used in connection with entirely different activities. Or, the doctrine might imply that these modifications are localized in specific parts of the central nervous system but that these parts with their modifications can be used again with entirely different activities. Both of these implications seem untenable.

Mental discipline results from such a modifica-

[1] See Bergström, *American Journal of Psychology*, June, 1894. "The Relation of the Interference to the Practice Effect of an Association"; for different opinions, see Henderson, *Text-Book in the Principles of Education*, 1910, pp. 306–8, and our quotations from Judd and Bair.

tion of specific parts of the central nervous system as will render future action along specific lines easier and more efficient. The aim of education is the control and direction of activity in the pursuit of certain ideal ends, and this aim is partly realized through discipline in the control and direction of activity toward these ends. In other words, the individual is educated through such responses to specific stimuli as will modify the specific parts of the central nervous system that he will use in adjustment to his environment. These modified parts represent the subject-matter of activity, the content in regard to which the activity has been controlled and directed, or the method of activity, the form in which the activity has been controlled and directed. Though these parts can be used again in new associations of subject-matter or of method and the benefit of the previous modifications can thus be transferred to a partially new activity in so far as it makes use of these parts, there is a probability that such new associations and new uses of these modified cells will not be made unless the associations are worked out or suggested by or for the individual. The parts of the central nervous system representing subject-matter may not be the same as those representing method in regard to this subject-matter, but the close associa-

tion formed by practice between the two makes it difficult to use the one without the other. They tend to form a closed circuit. Therefore, it is necessary in education to break or enlarge this circuit by using in whole or in part the same subject-matter in association with different methods, and by using in whole or in part the same methods in association with different subject-matter. And even when several associations have thus been worked out or suggested, there is a tendency for the older or stronger associations to assert themselves and interfere with the newer or weaker associations, especially if the latter are radically different from the former. Consequently, effort should be made to develop as the strongest associations between specific subject-matter and specific method those that are of the most environmental value. The wide transferability of many specific disciplines can thus be proved a reality in educational practice comparable in extent and value with the unrealized claims for formal discipline.

Experiments have shown that children and adolescents break up old associations and form new ones more easily than do adults. Therefore they show more quickly and to a greater extent the transfer of the effects of practice from one association to another. The common elements in the two

functions are more readily usable in both. This is due to the greater plasticity of the nervous system of children, to their limited experience, and consequently to the smaller degree of fixity and strength of the earlier associations. This fact is of great importance in the education of the young, because childhood and youth are the golden periods for associating and using the elements, modified by special training, in the various functions in which the transfer of the effects of practice will be of great value.

Most modifications of the doctrine of formal discipline are based upon some theory of localization. But Thorndike is the only author who carries this theory to its extreme conclusion: "There seems to be no structural arrangement by which the changes wrought by practice in one set of nerve cells could infect other cells with a similar quality." "By identical elements [in two functions] are meant mental processes which have the same cell action in the brain as their physical correlate." [1] O'Shea gives in one sentence a similar but more cautious reason for modifying the formalist doctrine: "We should infer from current theory respecting the methods of neural action, that exercise of any special kind would furrow out

[1] Thorndike, *Educational Psychology*, 1903 Ed., pp. 30, 81.

channels for the discharge of energy in support of just this kind of activity, but not an activity of a different sort." [1] Wardlaw has expressed the same idea in a striking analogy: "If I have broken a path through the weeds, I can cross that field more easily thereafter. This fact does not mean that the muscles of my legs are bigger than before, but simply that I am using the same path again—not that I have more strength to work with, but that there remains less work to do. And so, with the mind, there is a great difference between increasing a general power and increasing facility by using acquirements already made." [2] Bolton has recently discussed the problem more fully: "The theory of the localization of function and all the facts supporting it are arguments against the theory of formal discipline. Special localized areas and special functions could never have been developed had not the effects of exercise been cumulative at certain points rather than evenly diffused. Nourishment was supplied to the particular parts in excess of that supplied to any other parts. Consequently growth and development followed in the particular directions..... If the doctrine of general powers were true, it

[1] O'Shea, *Dynamic Factors in Education*, 1906, p. 75.

[2] Wardlaw, *Educational Review*, January, 1908, "Is Mental Training a Myth?" p. 28.

would be inconceivable that localization and specialization should ever have taken place. Any organ ought, according to that theory, to be able to control any function, and an undifferentiated, homogenous structure would have served equally as well as the exceedingly complex, specialized brain which we possess. With the gradual isolating, insulating, and specializing of functions, however, efficiency has arisen." [1] On the other hand, Colvin warns against the arguments for extreme localization: "The faculty psychology assumed a number of fabulous entities which worked out the destinies of the individual, while the doctrine of absolute localization of nervous function has made the brain a machine of relatively unrelated parts and has created a doctrine of psychic atomism which is as untrue as it is impossible of practical application." In a second edition of his monograph, Colvin adds this further criticism: "If we try to overthrow the doctrine of transfer on the ground of absolute localization of nervous functions, we are doing so on dubious theoretical grounds and holding to a theory which runs counter to what we know of mental elements and mental organization. If, on the other hand, we accept the doc-

[1] Bolton, *Principles of Education*, 1910, Chap. XXVII., "General Discipline and Educational Values," pp. 753, 754. See also, Henderson, *Text-Book in the Principles of Education*, 1910, p. 43.

trine of relative rather than absolute localization, of colligation of remote functional areas, and of vicarious functioning (as does Wundt), we find that such an hypothesis, instead of making against the possibility of transfer, gives a clear basis and reason for such transfer. Indeed, a rational hypothesis of cerebral localization suggests co-operation and transfer of the widest possible sort." [1] And finally, Ruger even goes so far as to say that "the definition of identical elements in terms of common cell action in the brain is of value only as a demand for explanation." [2]

[1] Colvin, *Some Facts in Partial Justification of the So-Called Dogma of Formal Discipline,* 1909 and 1910, University of Illinois, pp. 6, 23. See also, reviews (listed in Index) of our first edition by Bagley, Cousinet, and Dearborn.

[2] Ruger, *Psychology of Efficiency,* 1910, Archives of Psychology, No. 15, p. 85.

CHAPTER VI

GENERAL CONCEPTS OF METHOD

If acquired abilities are specific, not general, does it follow that there are no general results from specific mental discipline? The experiments on transfer suggest not only the transferability of the effects of practice from one function to others which are similar in greater or less degree, but also the transferability of the effects of practice from one function to others which have little recognizable similarity in their specific subject-matter or their specific method. Is it not possible to be consistent with the results of these experiments and with our previous emphasis upon the specific character of training and still grant that there is a general benefit to be gained from this training over and above the possibilities of wide transferability, not the general benefit claimed by the formal disciplinists but one of great value in mental development? If so, how can such a general benefit be

gained? The quotations in chapter II by Thorndike, Bolton, Colvin, and Rowe and those by Ruediger and Henderson at the end of this chapter are suggestive answers to this question. We add here a quotation from Bagley, which has had great influence in directing thought to this phase of the problem.

"The doctrine of formal discipline assumed that the mastery of a certain subject gave one an increased power to master other subjects. It is clear that there is a certain amount of truth in this statement, provided that we understand very clearly that this increased power must always take the form of an ideal that will function as judgment and not of an unconscious predisposition that will function as habit. In other words, *unless the ideal has been developed consciously, there can be no certainty that the power will be increased, no matter how intrinsically well the subject may have been mastered*..... An ideal is a type of condensed experience. It is the upshot of a multitude of reactions and adjustments, both individual and racial. Because it is a type of condensed experience, it is commonly formulated as a proposition or conceptual judgment. Or it may be attached to a single word.....The development of an ideal is both an emotional and an

intellectual process, but the *emotional element is by far the more important.*" (Bagley.)[1]

While agreeing in the main with the points of view expressed by these authors, we prefer to state the matter thus: A general benefit can be derived from specific training in so far as the person trained has consciously wrought out, in connection with the specific training, a general concept of method, based upon the specific methods used in that training. The building of such a concept follows the same laws as does the building of other concepts. The common elements in a number of specific methods are abstracted and bound together in a general concept of method, a general rule or principle of how to do, how to act, in situations of a certain general type. These concepts may be held in the mind in one or more sentences, in a single phrase or a single word, in a metaphor or a line of poetry or some traditional maxim, in a formula of mathematics or chemistry or engineering. In all cases the symbol stands for a method of activity, be it in the realms of pure or applied natural science, of social science or practical civics, of business or professional life, of personal manner or social relations. The mind

[1] Bagley, *Educative Process*, 1905, Chap. XIII., "Formal *versus* Intrinsic Values of Experience: The Doctrine of Formal Discipline," pp. 216, 222, 223.

stores up by means of this symbol the rules and directions to guide its activity in adjustment to those phases of the environment to which such an activity seems applicable.

It is necessary at this point to emphasize three important distinctions. The first is the distinction between *what* to do and *how* to do it. The former is subject-matter, the latter is method. The ideals of the what and the ideals of the how ought not to be confused in thought, though they may be closely related.

The second important distinction to be emphasized is that between a widely transferable acquired ability in the use of some specific method and a generalized acquired ability in the use of several methods. The former is the result of activity in dealing with a concrete situation in a specific way and can be transferred to another situation only in so far as the method used is common to both. No matter in how many situations a given specific ability may thus be used, it still remains specific; it never becomes generalized and usable in situations which do not have elements of method in common with it. As has been suggested before in this essay, there is frequent confusion at this point, especially because some specific methods have elements in common with a

large number of other methods and therefore the abilities developed by the use of the former are widely transferable. But this transferability is far different from general mental discipline, from generalized abilities, powers, habits.

The third important distinction is that between a widely transferable acquired ability and a general concept of method. The one is power and efficiency to perform specific activities; the other is an intellectual proposition or judgment as to how activities of a certain general type should be performed. The one is ability to do; the other is knowledge of how to do. These are often spoken of as one and the same thing, but a little reflection will make evident the great difference between them. To know how to do, how to apply oneself, how to reason, how to control one's desires, is part of the victory, but it is only the initial part. It guides us in developing an ability, it eliminates much of the trial and error otherwise necessary, it focuses attention upon the required steps, it short-circuits the process; but it does not bestow ability. Ability can be developed through the application of the general concept of method to a specific situation, but it is only by specific activity and neural modification that we can acquire an ability. We may know how to be good, reason-

able, efficient, but we do not actually become good, reasonable, efficient until we have practised, in specific situations, these virtues and incarnated them in specific deeds. It is the doing that makes us what we are. In fact, our knowledge of how to do, our concept of method, is really never complete until we have thus applied and tested it in specific deeds.

Can the formation of such a general concept of method from specific methods be explained on the afore-mentioned hypothesis of localization of function to specific parts of the central nervous system? The conscious formulation of the concept into words or sentences synchronizes with stimulations and consequent modifications of specific parts of a word or a concept centre of the cortex. Only in some such way does it seem possible for the concept to be registered in the brain. The modifications in these specific parts cannot, of course, be generalized, but they can be made generally usable through their associations with different parts of the cortex and the central nervous system, connected with different specific activities. These specific activities include those which, through their common elements, formed the original basis of the concept and also those which, through their common elements, will be subsequently guided by

the concept. A general concept of method is, therefore, a centre, a clearing-house, connecting the previously used specific methods of a certain general type with the subsequently used specific methods of that type. This does not mean that the parts of the central nervous system used and modified in a previous activity need be used again in a subsequent activity, unless it is necessary to vitalize the central concept guiding the second activity by reference to the concrete basis upon which the concept was built. As the general concept of method can be used for guidance in several activities, it can be considered a common, transferable element in them all; but this common element, this connecting link, is one of knowledge of how to do, not of ability to do. It can be a central guide even when the activities and the abilities derived from these activities are different and non-transferable.

We repeat that it is through general concepts of method, not through general discipline, that specific methods and training can be made generally beneficial over and above their use in functions in which they form an essential part. The more numerous and varied the specific methods from which the common elements have been consciously abstracted, the more widely applicable is the gen-

eral concept of method for the person who formed it. Of course, all these specific methods need not be worked out or observed at the time when the concept is formed. The specific methods used at the time may be limited in number and variety, but subsequent experience may add other methods and thus extend the applicability of the concept. Furthermore, all of these methods need not at one time or other be worked out or observed in the concrete; some of them can be imagined from a knowledge of other situations to which similiar methods would apply. The essential thing in forming a general concept of method, with vital meaning and wide applicability, is to work out, or (in a less degree) to observe others work out, the specific methods from which the general concept can be formed. Then, after comprehending the value of the method in dealing with the specific situation or situations, the pupil should work out, or, if that is not possible at the time, he should think out, its application to other situations. Upon such a wide basis in reality he should consciously build and hold his general concept of how to deal with these and other possible similar situations, applying and enlarging it as later experience gives him opportunity for so doing.

General concepts of method can be formed

without as systematic or elaborate a process as is here suggested. Many are derived by pupils from their school work without any realization of the steps taken. However, some such process is necessary, and upon its care and thoroughness depend the validity and extension of the general concept. Furthermore, ability to use the specific methods from which the concept is derived is not a necessary basis for the formation of the concept; only an understanding of the specific methods, only a knowledge of how to act in the specific situations, is essential. This understanding of methods is often gained at school without ability to use them, and, on the other hand, ability is often gained in the use of methods without an understanding of them. But an understanding of specific methods is never complete without ability to use them, and ability to use them is never complete without an understanding of them. Therefore, it is well to urge a careful, systematic procedure both in specific training and in the formation of general concepts of method.

What are the steps by which a teacher can *lead* his pupils to develop a general concept of method. First, he can lead them to recall and explain the methods previously used, which are similar to those to be worked out. Second, he

can lead them to work out and understand the specific methods used in connection with the subject-matter that is presented. Third, he can lead them to analyze and compare these specific methods in order to abstract their common elements. Fourth, he can lead them to bind together these common elements into a general concept of method. Fifth, he can lead them to apply, concretely or imaginatively, the concept thus formed to other subject-matter. Here we have the "five formal steps" used in developing a general concept of method, just as they should be used in developing other general concepts. Of course, these steps are only suggestive, not binding as some books would have us believe; but they do outline the successive stages in the mental process of forming concepts. With allowance for all the variations necessary under special circumstances, it must still be reiterated that these steps are a good guide for any teacher who strives to make his pupils derive general benefit from their specific activities and training.

Concepts of methods should be associated with sufficient emotional valuation and impulsion to make them effective in practice. But all voluntary acts need to be directly or indirectly motived by the emotions; the necessity is general and needs

no special emphasis here. The stress put by Bagley upon "the emotional element as by far the more important" in his "ideals" shows that he is thinking especially of those concepts of method for the application of which great emotional motivation is needed, as, for example, the general concept of how to be courteous to those we dislike or of how to deny ourselves in social service. But there are a large number of concepts of method for the application of which little emotional motivation is needed, as, for example, the general concept of how to test the logical steps in an argument or of how to sift source material. Furthermore, emotions generally centre around the object in view, the subject-matter, rather than the method; it is *what* we should do, not *how* we should do it, that is usually the centre of our emotional struggles. But the general concepts to be derived from specific training are those of method, over and above subject-matter. Of course, the method can be made an end of action, not a means, and we may like it or dislike it; but it has then been misplaced and misvalued. Its real value is to guide in the doing of what we have decided to do, after such motivation and choice as the situation demands.[1]

[1] Bagley says in reply, *Journal of Educational Psychology*, January,

In this connection it is interesting to compare a few discussions of the elements of method, or form, in mental discipline. In addition, reference should be made to some of the discussions and experiments previously outlined, which emphasize either the transfer of ability acquired in the use of certain elements of method or the formation of general guiding principles of how to memorize, how to pay attention, how to pick out the essentials in a test, etc. Some of the authors fail to make one or more of the three distinctions which we have pointed out as necessary for clearness in discussing the elements of method.

"For the empirical science of logic the term form, as applied to our intellectual processes, indicates a common element, or series of common elements, in those processes, which makes the theory of formal discipline at least intelligible

1910: "The concepts of scientific method, for example, can be more readily transferred from the high-school laboratory to the situations of later life if the pupil has a strongly emotionalized *belief* that the scientific method is really 'worth while.' Merely recognizing from the point of view of intellect that the scientific method involves unprejudiced observation and careful induction is one thing; *feeling* the worth of this method as the best known means of attaining truth is quite another." We have never doubted the value of emotional motivation in getting people to apply the principles they have; but we claim that the problem of giving emotional color to the formation and application of concepts of method is part of the general problem of emotional motivation in all instruction that looks to its outcome in action, as all instruction should. We argue against there being any unique emotional need here.

and apparently tenable as a doctrine of intellectual training. In other words, formal training is discipline in certain discoverable forms of intellectual activity." "Formal discipline is the practice of the mind in certain forms or methods of thinking which are 'common elements' in wide ranges of experience." "The one word which sums up the theory of formal discipline is method, or, rather, methods. It is the theory that the mind can be trained to do well certain kinds of work, to follow successfully certain methods of procedure." "For the carrying on of any pursuit, we need not only talent, native or acquired, but also information, interest, practice, before the work can be successfully done. Exercise in one function should not be expected, therefore, to give equal facility in the carrying on of another. Obviously it does not, and the degree of the difficulty of transfer is determined, not only by identity or difference in the formal elements, but also by differences and similarities in the contents as well. That such a position is in accordance with the results of investigation thus far will not, I think, be denied." (Meiklejohn.)[1]

"What are these formal elements? I am

[1] Meiklejohn, *Educational Review*, February, 1909, "Is Mental Training a Myth?" pp. 132, 134, 136, 138.

tempted to call them laws—the laws of nature, the laws of composition and succession of mental states, the laws of human intercourse and of human advantage." In any discussion of formal discipline, the forms of human activity, not the forms of the outside environment, are to be distinguished from content—the material with which or upon which the individual acts. Both the content and the forms of the environment furnish the subject-matter elements in mental discipline; the forms of dealing with this environment furnish the method elements in mental discipline. We must distinguish between forms of the environment, as we interpret them, and forms of human activity in relation to that environment. Later on, Delabarre makes this distinction and discusses those formal elements which we have preferred to call methods of activity. "There is still another class of what, I think, can with equal justice be called formal elements, to which I desire to direct your attention. These are the general forms, not of our apprehension of the world, but of our conduct toward its situations. We know them commonly as the fundamentally desirable moral qualities, the components of good character. We can easily see that included among them are sympathy, kindliness, fearlessness, truth-

fulness, justice, courage. These seem almost like the names of emotions. But they are more than that. They are desirable elementary forms of our attitude toward the world, our reactions upon it. Any one of them is a form, whose possession gives us good judgment in dealing with a wide variety of situations, and perhaps slow but finally firm acquirement of any one of them is of enormously more importance to us than the learning of any number of specific facts." Here we have an emphasis, which we also noticed in Bagley's discussion, only upon those methods of activity which require great emotional motivation for their application. "The formula of common elements is true, but of no practical value. Practically all mental processes have elements, formal or structural, in common. Not only does good training in any subject improve methods of learning, of attention, of work, of comprehension; but it is also true that all knowledge possesses some elements in common, and the number of these may be very considerable even in case of subjects that appear at first sight little related. The structural, technical, content-elements are very important, but they can be left more safely to individual need and individual endeavor. The formal elements are universal, or at least of wide application, and

hence are more helpful and more difficult to acquire. To them education should surely give its best attention. No one can be a mere specialist. Everyone needs formal material for correctly judging a wide variety of experiences and relations that are essential to life." (Delabarre.)[1]

The following quotation illustrates well a popular confusion on the subject, a confusion even implied in the quotations from Meiklejohn and Delabarre. Raymont makes a distinction for mental discipline between the matter and the method of instruction, but he gives general disciplinary value, general mental training, to the method, although denying it to the matter with which the method was used. He is really upholding the doctrine of formal discipline in regard to elements of method. "Mental discipline depends, not so much upon the subjects taught, as upon the method of teaching. Bad science-teaching will not improve the reasoning powers, but will leave the learner still under the thumb of authority and prescription; whilst good science-teaching will avoid this evil, and will also exercise the imagination, by opening out wonderlands as glorious as those of literature.

[1] Delabarre, *Education*, May, 1909, "Formal Discipline and the Doctrine of Common Elements," pp. 591, 593, 599.

On the other hand, bad literary and historical instruction will leave the imagination barren, whilst sound instruction in these branches will not only avoid this mistake, but will also furnish the means of abundant exercise in cautious judgment and valid inference." "Though the *method* of instruction should be carefully devised with a view to mental discipline, it is misleading to say that the choice of the *matter* of instruction depends upon considerations of discipline." [1]

"If we have analyzed the doctrine of formal discipline correctly, it is evident that its extreme advocates and its extreme opponents are both wrong. Knowledge and training are not merely specific in their application, but they also have a general value. This value arises through the factor of identical elements, of which there are at least three types [aim, method, and content], and it declines rapidly as the similarity of the material of instruction or training decreases. Because of this rapid decline we can conclude that this doctrine is valueless as a criterion for the selection of subject-matter. To depend or retain a subject on the basis of its disciplinary effect is to take a stand on an extremely slender support. Only intrinsic values serve as valid bases for such

[1] Raymont, *Principles of Education*, 1906 Ed., p. 100.

retention and defense. But after a subject has once been admitted on this basis, the formal values that exist should be given their full emphasis. This means no more than to say that the subjects should be taught as well as we know how to teach them. No subject has a supreme or peculiar value in developing methods of procedure or ideals that are of universal application, but all subjects may be so taught as to yield their quota in these respects; and it is to be especially emphasized that we get little of these formal values without definitely aiming for them. The general relations of aim, method, and content must be brought definitely and attractively to consciousness, and applied to the activities at hand. Only in this way can we make sure that these values will to a certain extent be generalized; and they will in addition vitalize our teaching."

In another chapter Ruediger discusses "the relation of form and content values." "The thesis here maintained is that the formal values never take rank above the intrinsic values, but that, while they may be quite coördinate with them, they are usually subordinate to them..... In life, method is for the sake of content, for the sake of results, and not for the sake of the method itself..... Valuable though method is, it cannot stand alone.

It is necessarily subordinate to content and cannot be taught except through content. This relation holds also in regard to the formal value that we have designated 'identity of aim.' Aims and ideals are relative to the concrete activities of life in school and in society, just as method is relative to content.....The transfer of mental function through identity of substance is not a gain through a formal value, strictly interpreted, but through a content value. This element accounts in part for the transfer of educational effect from one study to another, but the gain is received from the direct application of previously acquired knowledge." [1]

This argument is of doubtful validity. If the specific elements of method are kept in mind as specific and are not generalized by their essentials into general concepts of method (see our previous discussion), then their general use would be limited to the general use of the specific content with which they first developed, and their value might be considered coördinate with or even subordinate to, the content with which they were first associated. And any future specific transfer or application might be similarly valued in com-

[1] Ruediger, *Principles of Education*, 1910, Chap. VI., "The Doctrine of Formal Discipline," and Chap. IX., "The Elemental Educational Values: Formal Values."

parison with the specific content to which it were applied. But if specific elements of method are worked up into a general concept of method, the concept need not then be closely dependent upon the specific content with which its constituent elements were respectively and formerly associated, and it could be applied to new content, which might or might not have little or any similarity to the former content. In other words, the generalization of the common essentials of specific elements of method into a general concept of method gives these elements far wider and greater influence than they otherwise would have; it thereby gives them far greater value than the content with which they were first associated. The number and variety of such general concepts of method that would be worked out in education are small as compared with the number and variety of the content used in school and of the content with which the concepts might be used in the future. The consequently larger range and applicability of these concepts make them of supreme value in education, especially in secondary schools and colleges. If Ruediger's second formal value, that of "aim," is considered apart from method, our same argument would apply for the superior value of general concepts of aim or purpose.

The following quotation from Henderson is very valuable:

"It is evident that formal elements are relational in character. When one speaks of classes of situations, he has in mind usually, if not invariably, groupings according to form, such groupings as are based on the relation of the situations to our practical life. Neatness is a requirement of a form of situations, because it cannot be defined apart from the relation between its material and the persons who inspect or use it. Such relationships may be very general. Indeed, it is likely that they are far more general than are the content factors which they relate. The need of memorizing is more commonly encountered in experience than is any fact that one needs to memorize. It is difficult to draw a hard and fast distinction between the relational and the related factors, the form and the content, of experience. However, it is evident that where emphasis is thrown on relation, there we have form, and that there are certain fundamental forms that constitute typical problems, the power to deal with which is a constant asset throughout life. The acquisition of this power may properly be designated as formal discipline. Thus we may speak of training to attend, by which we mean to assume the physiologi-

cal or mental adjustments of attention, some of which are more and some less general, as being formal discipline in so far as it is independent of the content to which attention is given. Moreover, as the adjustments become more and more adapted peculiarly to one content, the merely formal character of the discipline would seem to be lost. . . . . If it seems natural and appropriate to designate one phase of a situation as its form, and another as its content, it must be remembered that the part of discipline in reference to each is the same; *i.e.,* to establish associations and reactions which these factors, when they recur, may invariably suggest. Moreover, discipline in adjustments to a few type forms would not be of any value if it were not sustained by familiarity with the treatment of a multitude of facts.

"But education, whether in form or in content, does not sum itself up in specific discipline, in the establishment of definite associations. It includes also general discipline, or the training of power to recognize the occasions for the use of habits or knowledge. . . . . Habits, like any resources, are made available, not alone by being shaken aloose from dependence upon a narrow group of accidental associations, but also by the acquisition of a great and varied mass of connections, acci-

dental or essential, so that their recall in a new concrete situation may not depend on too tenuous a thread." [1]

[1] Henderson, *Text-Book in the Principles of Education*, 1910, Chap. X, "The Question of Formal Discipline," pp. 312–14. See also, our quotation from Henderson in Chap. II.

CHAPTER VII

A STANDARD OF EDUCATIONAL VALUES

The doctrine of formal discipline, in its extreme form, implies that the mind is made up or possessed of certain general powers or faculties—memory, imagination, reasoning, etc. These powers are developed by exercise to a degree proportionate to the force and duration of the exercise taken, but the stimulus which calls forth this exercise of any power affects but little the kind of exercise and consequently the kind of development of that power resulting from such exercise. This development in strength, breadth, accuracy, etc. of the power involved can be used in response to any other stimulus than the one by which the power was previously exercised, with little change in nature or diminution in amount. The different powers are considered like different tanks or reservoirs with many pipes emptying into them and many draining out of them. No matter through what pipe water gets into the tank, it can go out by any other pipe and continue almost unchanged through

the entire process. The practical problem of mental discipline in education then resolves itself into (1) deciding what are the power tanks (memory, reasoning, etc.) to be filled by school education; (2) selecting the largest usable pipes to carry water into each tank; and (3) forcing water through these pipes into the tank until the supply is considered sufficient to meet any and all demands. When any given subject, say mathematics, is defended on this doctrine, the implication is that it is the largest usable pipe for carrying water into the tank of reasoning or accuracy or some other power, and therefore more of the desired power can be accumulated through this pipe than through any other. Or a given subject may be defended because it consists of a number of pipes carrying water to several power tanks, reasoning, accuracy, attention, etc.

Of course the doctrine of formal discipline is not held in this extreme form by many of its present adherents, but the above analogies represent roughly the traditional and logical conclusions of their position. Whatever modifications and limitations these adherents make seem to us to be in the direction of an emphasis upon the specific nature of mental discipline.

The doctrine of specific disciplines, on the other

hand, claims that there are no such general powers or faculties—memory, imagination, reasoning, etc., but that these names stand for vague classifications of mental responses to stimuli. The mind develops in a specific manner by practice in response to specific stimuli, and the benefit of this development can be fully used only in future similar responses to stimuli similar in whole or in part to those which called forth the previous responses. This benefit decreases just in proportion to the amount of dissimilarity between the future and the previous stimuli. To refer to the afore-mentioned analogy (which, of course, is in no way exact), the opposition holds that there can be no tanks or reservoirs of general power, with many pipes emptying into them and many draining out of them. Each pipe collects, holds, and discharges the water flowing into it, though there may be many connections with other pipes. The practical problem is to choose pipes of the most specific value and then force water into them. Mathematics, for instance, would be defended on this doctrine because of its great specific value in developing ability to reason, to be accurate, etc. in regard to the mathematical elements in the environment.

As the following standard of educational values is based upon the doctrine of specific disciplines, supported, we believe, by experimental evidence and general observation, its main emphasis is upon the specific or intrinsic value of each element of subject-matter or of method in the school curriculum.[1] This value is determined by the environmental importance of the element and consequently by the environmental usefulness of the specific ability developed by the element. As a specific element of subject-matter or of method may appear in various combinations in the environment, the specific ability developed by it can be used with as many of these combinations as are recognized as containing the given element. The value of these elements is therefore determined objectively and sociologically, but when brought into the school they should be so arranged and interpreted as to appeal to the pupil at successive stages of growth, and also to

[1] Colvin makes a valuable suggestion as to the possibilities of transfer "when the reaction is under the dominance of a mood or emotion that so colors the objective environment that several different stimuli may call forth the habitual response." It seems to us that here we have common elements of emotional response in two or more functions and that these elements might well be considered one of the three common elements—subject-matter, method, and emotional response—which make transfer possible. The "aim" emphasized by Ruediger might be considered a fourth common element, but we would prefer to include the element of aim as one of the elements of method.

reveal to him their significance in the various combinations in which they appear in the environment.

Out of the specific elements of method can be formed general concepts of method, but these concepts should be derived from methods of the most specific value in the environment. Thus can be realized two educational aims—training in the use of valuable specific methods, and the formation and application of valuable general concepts of method. To seek these aims separately, giving one study for its specific value and one for its general method value, is clearly a waste of the most precious asset of the school, namely, the child's energy. It may be that in one study one value will be emphasized and in another study the other value will be emphasized, but with few exceptions the studies of the most specific value will be those of the most general method value. Therefore, it is certainly the wisest policy to base a criterion of studies upon the specific value of their elements of subject-matter and of method.

The elements of studies that are common to the present or future environments of most of the pupils are the elements to be studied and tested in working out a school curriculum; the other elements are to be eliminated, no matter what

traditional emphasis may have been given them. As even the important elements in the environment are far too many to be included in elementary and secondary curricula, also among them must there be a rigid and relentless selection. Every included element must have proved its supremacy over the competing elements that might have taken its place if such a test were not carefully enforced. "The question which we contend is of such transcendent moment, is, not whether such or such knowledge is of worth, but what is its *relative* worth?" (Spencer.)[1] *In how many and in how important ways (quantity and quality of usefulness) can the specific element be used by the pupil in adjustment to his environment? Here is our basis of comparison between elements, and there is no reason why each and every element of each and every study should not be subjected to such a comparison.* To select the most valuable elements and organize them into a graded curriculum ought to be the chief purpose of school administration. "As the educational aim is the unfolded and capable mind in the concrete social and natural situations of life, and as we are efficient in those situations in proportion as we have developed ourselves earlier in

[1] Spencer, *Education,* 1861 Ed., p. 28.

similar situations, it follows that those subjects have the greatest educational value which have the greatest number of identical elements with the situations of life. . . . . A new problem is proposed to educational theorists at this point, viz., to go through our subjects of study with a view to determining what and how many elements they have in common with life." (Horne.)[1]

Of course, our standard is a utilitarian one.[2] It would be wasteful and wrong to have any other. But this standard is by no means that of a narrow, materialistic utilitarianism; it simply stands for the test of usefulness to the whole person in relation to the whole environment, emphasizing especially those ethical, intellectual, and æsthetic ideals that minister to the best uses of the human spirit. A general development can be promoted by useful responses to important phases of the environment far better than by the hypothetical all-roundness of an arbitrarily chosen group of cultural or of formal disciplinary studies. It is

[1] Horne, *Education*, May, 1909, "The Practical Influence of the New Views of Formal Discipline," p. 616. See also, Horne, *Psychological Principles of Education*, 1906, Chap. VI., "The Theory of Formal Discipline"; Tompkins, *Philosophy of Teaching*, 1891, p. 266.

[2] Cousinet, *L'Educateur Moderne*, April, 1910, p. 190: "Il y a dans ces formules une tendance bien américaine à l'utilitarisme, M. H... le reconnait volontiers (p. 115), que je juge dangereuse et contraire à une bonne discipline intellectuelle. Encore est-il juste de reconnaître que M. H... échappe un peu à cette critique par l'importance qu'il donne à la méthode."

a sad commentary upon our educational abstractness that we often fail to realize the high and noble inclusiveness of the ideal of use in our preparation of boys and girls for efficiency and service in society. We sometimes run away from the real test of real things and cry out for culture, as if culture had any meaning apart from its use in adjustment.

It is especially important in teaching to lead pupils to recognize the various environmental relations and uses of the elements of subject-matter or of method which are brought into the school. If pupils are not thus guided they may fail to see these relations and uses and consequently may fail to apply the knowledge and abilities developed in school to those phases of the outside environment to which they should be applied. Of course, no relation is to be brought into the school which is not in the environment; to trump up artificial relations between elements for school purposes—to stimulate interest, etc.,—is misleading and almost dishonest. But as a given element of subject-matter or of method may be environmentally related in a number of different ways to a number of different elements, the limited time and energy of the pupil necessitate a comparative test and a rigid selection of these relations, so as to

bring into the school only those that have the greatest quantity and quality of environmental usefulness. The test will therefore be similar to that of the elements themselves; in fact, it is but part of the latter, because the values of the elements cannot be comparatively determined without a comparative test of the values of their relations. This is why many teachers do not know the subject-matter or method they teach; in knowing the elements apart from the environment which gives them value they really do not know what their value is. This is probably the weakest point in our teaching force,—the ignorance of teachers regarding the environmental relations and values of school studies. Their training should be more in practical sociology and less in hypothetical pedagogy, and a far greater emphasis upon the social relations of the curriculum is needed both in normal school and in university courses for teachers.

However suggestive may be the various schemes of concentration or correlation, they can never be widely accepted, because the centres of their circles are not the centres of the environment. The elements are not thus centripetalized in actuality. Therefore, in school they should be interpreted only in those inter-relations that rep-

resent, explain, and emphasize their comparative environmental nature and significance, the same elements, if necessary, being brought into the course again and again to reveal new relations and to help in apperceiving new elements.

It is not denied that elements and relations not directly useful in themselves must be included as a preparation for elements directly useful, but this indirect usefulness may be of more comparative value than the direct usefulness of some competing elements. It is also not denied that logical consistency and completeness sometimes require the introduction of elements and relations not directly useful in themselves, in order to bind together those elements of a subject that have been selected as of the most comparative value. The elements thus introduced would then have to stand the test of their usefulness in binding together directly useful elements. Furthermore, the logical consistency and completeness of a text or course must in themselves be tested. They should not exceed the logical consistency and completeness necessary for the proper use of the elements of that text or course in their environmental relations, or for the proper illustration of specific methods which are to be worked up into valuable general concepts of method.

Thoroughness is another untested school ideal. Thoroughness has no meaning in the abstract; it must be judged by some standard, for some purpose. Elements of school work must be taught as thoroughly as is necessary for their proper use in the environment and for the proper illustration of specific methods. In other words, thoroughness must be valued according to its functional significance.

Let it not be supposed that the standard as outlined interferes in any way with the adjustment of the curriculum to successive stages of the pupil's development. There is no essential opposition between the selected elements and relations of the environment, which are brought into the school, and the developing capacities and interests of the pupil. The present opposition is one of the artificialities of school work. Dewey argues powerfully that "the child and the curriculum" can be vitally related, that the experience of society represented by the curriculum can be arranged, interpreted, "psychologized" for the child in such a way as to be assimilated by him and become his own experience. The outside environment must be made into the meaningful school environment of the pupil, and there is no need why, in this process, the elements of the outside environment

should be misrelated or misvalued. On the other hand, it is only in so far as these two environments are similar that the child lives in school a life that has a functional value outside. And this is the way to develop a true, educative interest, rather than an artificial interest, in school work, by arousing in the child a desire to express himself in response to those phases of his school environment which he recognizes as also important in his outside environment. With this limited outside environment as a starting-point and a constant source of reference, the school should continue to enlarge the child's experience through the knowledge and activities of a larger environment, the epitome of that outside environment for which he is being prepared. Thus will his school environment and his outside environment together grow into that of the intelligent adult citizen, and thus will his specific abilities to meet the opportunities and responsibilities of his adult life be developed by meeting the opportunities and responsibilities of his constantly enlarging school life.

It may be objected that both the present and the future outside environment of each individual pupil are so different from those of any other pupil that it is impossible to select, by any comparative test of an environmental usefulness, elements with

which to organize a uniform course of study for the masses of children in the public schools. Such an objection really denies the possibility of making any suitable uniform course of study at all. If we cannot make one by selection according to environmental values, we certainly cannot make a better one by selection according to any other kind of values. The public school system is based upon the belief that at least the great majority of pupils have now and will have in the future a community of need, interest, and responsibility. This community is represented by the minimum requirements in the course of study, representing the essential elements in the common present or future environment of most pupils. Opposition to this common ground of school work is due to a failure to realize that the like-mindedness of the citizens, as Giddings suggests, is a fundamental necessity in a democratic society, and that our public schools, through their common courses and interests, ought to lead in developing this like-mindedness. Above a minimum course there should be room for individual variations in advanced and parallel work and, even within this minimum, allowances should be made for individuality of response to the subject-matter and methods given. But if there is to be no common course for our

public schools, in city, county, or State, our education will carry individualism to an extreme and will lose its great mission of being one of the principal cohesive forces in society.

This standard of educational values also applies to school management. The motives, routine, discipline, etc., of school life can be analyzed into elements of subject-matter and of method and can be tested for their environmental values. It is wasting a great opportunity to compel pupils into an artificial regime, when the very organization and processes of the school community ought to prefigure and prepare for the community outside. If this ideal is introduced into school management, it will become a great force for social efficiency and for ethical training by developing through social relations those specialized habits and general concepts that will make for good in the individual and in the environment. What is needed is not necessarily a "school city" or a formal copy of some social organization, for these may or may not interpret the spirit of society and therefore may or may not be educative. The community life of the school must emphasize the standards, responsibilities, and methods of the community life outside, in so far as the school can use these for educational purposes. The doctrine

of formal discipline cannot apply here any more than elsewhere. Specific subject-matter and method, specific training and abilities, general concepts of method—these are the materials, methods, and results of the ethical training that should come through school motives and discipline. If these materials and methods are those common to both the school and the outside environment, the results will be of untold value; but if the materials and methods of the school are artificial, the results will be of limited value. Through society are we educated for society.

Before the standard developed in this essay is applied, for the purpose of illustration, to some phases of elementary and secondary school curricula, it will be profitable to compare a few standards of educational values, set by writers opposed to the doctrine of formal discipline. Four are by educationists and two by sociologists.

"The ability to deal with any situation depends upon one's having had experience with some similar situation. And the educationist will so plan it in view of this principle that the individual will in his educational course be made ready for those general and special duties which he will perform as a member of a community.....He will exclude everything which does not give very good

proofs of its suitability to assist the learner in his relations with men and things, by presenting to him now situations which he will encounter, though it may be in a more complex form, in later life. In the matter of studies purporting to be of social value, for example, the educationist will proceed upon the doctrine that if the individual can be got to react in desirable ways to social situations actual or ideal during the developmental period, then he will acquire modes of reaction which will be serviceable to him in all times and places. The educationist will cast out everything which cannot return an affirmative answer to the question, Will the individual in mastering you be making in the best way adaptations which he will be required to make as a member of a social organism?" (O'Shea.)[1]

"The educational values of different subjects, *i.e.,* their efficiency in promoting the realization of the aim of education as defined above [to prepare for complete living], consist (a) in the scope, kind, strength, and permanence of the incentives to activity; and (b) in the kind, degree, and permanence of the power to think and execute that those subjects may develop.....The kinds of incentives to activity, whether intellectual, æsthe-

[1] O'Shea, *Education as Adjustment,* 1903, pp. 288-291.

tic, moral, or constructive, derivable from the course of study, depend on content (the nature of the subject-matter). Since incentives are impulses to activity growing out of interest in the subject-matter, they will develop strength and permanence when interest in the subject-matter is strong, real, and permanent.....Power means ability to do something—to bring about results. The results achieved will always be in some one field of activity, however; and the kind of power developed through the pursuit of a given subject will consequently be usually restricted to power in dealing with data of a particular sort..... There is no such thing as power in general that can be cultivated through the pursuit of any one subject, and can then be drawn upon at any time for successful achievement in other subjects. .....The power developed will always be chiefly specific: but if, through correlation, the mutual ramification and interdependence of subjects are traced; and further, if the method of one subject is explicitly carried over to other subjects to which it can be legitimately applied, the power developed will also be to some extent general." (Hanus.)[1]

"With the abandonment of the dogma of

[1] Hanus, *Educational Aims and Educational Values*, 1899, pp. 7-10.

faculty discipline, which assured us that all the powers of the mind could be acquired by formal exercises in dead languages, school mathematics, etc., there clearly remains but one alternative—to train the pupils for the specific goal it is desirable to reach. This alternative permits no compromise. The exercises which prepare for life are the duties, knowledge, and emotional attitudes of existing life itself, which the world's workers are currently using. The alternative recognizes that like produces only like, and, therefore, repudiates those exercises such as Latin or algebra, which in themselves are acknowledged to be unused, except as mental trapezes of the schoolroom. It requires that the pupil's energy shall be centred upon the mastery of those things which existing world life requires of its active and productive journeymen; anything less is insufficient, and anything of a different character is irrelevant. How shall we obtain such a course of study, and who shall systematize it? Manifestly, the first step in the task is to catalogue the essential duties, items of knowledge, and emotional attitudes current in the world's usage. This material must then be set up and arranged in the schools as goals of instruction, and the business of the pedagogue will be to enable the pupil to acquire these world-used ma-

terials to an effective degree as readily as possible." (Burk.) [1]

"The implication intended is that subjects should be studied because they are intrinsically valuable; because the possession of a knowledge of them is distinctly worth while. One of the highest arts of the pedagogue is to make the pupil see and appreciate these values and consequently to be so attracted by the acquisition that he is unsatisfied without them."

"A critical consideration of formal discipline leads to some very important conclusions concerning the purposes and arrangement of a course of study. (1) Education is a process of adjustment of the individual and the race to varying situations to secure their highest welfare. (2) Particular adjustments demand particular experiences which cannot be furnished by any sort of general gymnastics. (3) Therefore, each type of adjustment must be secured through special appropriate forms of experience. (4) As life is so complex, a great range of experiences is demanded to fortify the individual for his multiform situations. (5) The curriculum should represent prevised or preparatory

[1] Burk, *The World's Work*, July, 1909, "The Bankruptcy of 'Education,'" II., pp. 11764, 11765. See Burk's interesting but exaggerated attack on the doctrine of formal discipline in the June number of the same magazine.

experiences as well as permanent life experiences and hence must be varied. If limited in scope it denies experiences necessary for the varied development of each individual, and also fails to provide equally for all. (6) It is necessary to bear in mind that the education of the human race which produced the high degree of development which it now possesses was nearly all secured before schools and formal studies were invented or arranged. (7) Racial education was nearly all gained through intensely practical and utilitarian means..... (8) In our scheme of education we must not forget the basal primitive means of culture. Schools and the formal school arts are not absolutely necessary..... (9) My meaning is now, I trust, clearly apparent. All school arts should be developed out of life's pursuits and in turn contribute to the better accomplishment of these activities." (Bolton.)[1]

"The prime problem of education, as the sociologist views it, is how to promote adaptation of the individual to the social conditions, natural and artificial, within which individuals live, and move, and have their being..... Sociology has no tolerance for the pedantry that persists in

[1] Bolton, *Principles of Education*, 1910, Chap. XXVIII, "General Discipline and Educational Values," pp. 768, 769, 770.

carpentering together educational courses out of subjects which are supposed to exercise, first, the perceptive faculty, then the memory, then the language faculty, then the logical faculty, etc. On the contrary, every represented contact of a person with a portion of reality sooner or later calls into exercise every mental power of that person, probably in a more rational order and proportion than can be produced by an artificial process. Our business as teachers is primarily, therefore, not to train particular mental powers, but to select points of contact between learning minds and the reality that is to be learned. The mind's own autonomy will look out for the appropriate series of subjective mental process. In the second place, our business as teachers is to bring these perceptive contacts of pupils' minds with points of objective reality into true association with all the remainder of objective reality, *i.e.*, we should help pupils first to see things, and, second, to see things together as they actually exist in reality. In other words, the demand of sociology upon pedagogy is that it shall stop wet-nursing orphan mental faculties and find out how to bring persons into touch with what objectively is, as it is. The mind itself will do the rest." (Small.)[1]

[1] Small, *American Journal of Sociology,* May, 1897, "Some Demands of Sociology Upon Pedagogy," pp. 842, 843.

"The only thing that can 'develop' or 'strengthen' the faculties or the mind is knowledge, and all real knowledge is science. The effect of this on the mind is to furnish it with something. It constitutes its contents, and, as we have seen, the power, value, and real character of mind depend upon its contents. Without knowledge the mind, however capable, is impotent and worthless. But there is a great mass of knowledge in the world. It does no good unless it is possessed by the mind. It is a power as soon as it is possessed by the mind. It is as useful to one mind as to another. It is the only working power in society, and the working power of society increases in proportion to the number possessing it,—probably in a greater proportion. Only a few minds possess any considerable part of it. All are capable of possessing it all. The paramount duty of society, therefore, is to put that knowledge into the minds of all its members." (Ward.)[1]

[1] Ward, *Applied Sociology*, 1906, p. 312. There is a failure here to distinguish clearly between knowledge and ability.

CHAPTER VIII

THE ELEMENTARY CURRICULUM

What are the elements of subject-matter and of method which are repeated over and over again in such important ways in the environment as to necessitate their being included in the school preparation of the great majority of people in that environment? Germany and France have answered this question with far more national unanimity and success than we can hope to attain in this country, because our local control and diversity of conditions render such uniformity undesirable and impossible. Is it not possible, however, for our States, individually if not collectively, to select a minimum of elements in language, arithmetic, geography, etc., which will be common and valuable to the present or future environments of the great majority of their elementary school pupils? These elements will be selected on account of the superior number and importance (quantity and quality) of their uses in the environ-

ment, in comparison with other elements competing for their places in the curriculum.

A glance at many text-books used in our schools reveals a collection of elements of all degrees of value, from zero up to the highest. Especially is this true in arithmetic, geography, and history. And, far more significant, these elements are often not graded or emphasized so as to show their value as compared with each other; on the dead level fact *versus* fact both teacher and pupil become bewildered in interpreting the usefulness of the elements presented. The amount of space and time devoted to this or that element is often disproportionate, above or below, their real value as judged by a true environmental standard. The emphasis put upon a given element in school should reflect the emphasis put upon it in the environment. The difficulty in mastering an element of subject-matter or of method might cause it to take up more time and attention in school than its comparative value would justify; but this would be unusual, if the element were properly placed in the curriculum and the proper preparation were made for it. However, if the time and attention required to master the element would still be far in excess of its real value, then there

would be doubt as to its right to a place in the curriculum at all.

McMurry has well criticized the lack of proper emphasis in courses of study and has outlined a topical scheme based upon the comparative usefulness of the elements. He also shows how such a scheme would eliminate many elements of comparative uselessness, now emphasized on account of their supposed disciplinary value. "The idea that the discipline gained will make up for all losses is one of those long-lived myths which is at last rapidly disappearing before a more rational view of education. A large proportion of the time of children is now wasted by excellent teachers in gaining a formal excellence in studies which is beyond the present needs of the children, and has no defence except on the basis of the exploded doctrine of formal discipline." [1]

The present necessity is for an elimination of the less important elements and a graded scale of emphasis upon the more important. The overcrowded curriculum would then be reduced in amount, confusion, and strain. Room would be made for those new elements that by their comparative value deserve places in the curriculum;

[1] McMurry, *Course of Study in the Eighth Grades*, 1906, Vol. I., pp. 47, 48.

nature-study and manual training would be represented proportionately to their environmental usefulness; domestic, industrial, and commercial elements would be free to assert their value and rights in elementary education. Progressive changes in the environment would cause progressive changes in the curriculum, by the elimination of old elements, the introduction of new elements, or a redistribution of emphasis upon the elements. And, over and above the minimum requirements for any State system, or even for any local system, there would still be room for elements of special usefulness to individual pupils or groups of pupils according to their abilities, tastes, or future occupations.

There is no overwhelming difficulty in working out an agreement as to the elements of arithmetic, geography, history, etc., which will *identify* the school environment with the outside environment. What are the most important present uses of decimal fractions? These certainly can be determined. Then put these and only these uses in the curriculum. What are the elements of knowledge about the German Empire most often required of our citizens generally by our present relations to that country? These certainly can be determined. Then put these elements and only these

in the curriculum. What are the facts about the Louisiana Purchase necessary for the mass of our citizens to know? These certainly can be determined. Then put these facts and only these in the curriculum. And so on through the elementary school studies.

We claim that these elements can be selected after careful appraisal by experts and that only in such a way can a curriculum be formed that will have the most functional power for the largest number of pupils. To claim that it is impossible for any group of people to realize an environmental standard of comparative values in making out a curriculum is to deny the possibility of intelligent guidance in education. We do not claim that the elements of most comparative value can be selected by this or that text-book author or publisher, however good he may be, for such a selection requires a broader, deeper knowledge of environmental values than one man can possess. Through expert committees, appointed by States or by professional associations, the best and most comprehensive knowledge available should be brought to bear upon the selection of elements for courses of study in the public schools. Rather than have these courses blindly conform to this or that text-book, which may or may not

have any creditable or consistent selection and valuation of elements, the courses should represent and realize the best standard that the specialists can make. Then, to this standard text-books should be made to conform. The choice of the mental food and exercise of hundreds of thousands of children is far too important a problem to be left to a text-book author, to a publisher, to an official, or to a lay board of trustees. The lackadaisical way in which the selection of the curriculum is left to anybody or everybody is cause for a serious indictment of the educational profession. No wonder we are skeptical about ever knowing the value of this or that element, when we take so little care about the selection of it and rely upon a crude empiricism to test it.

The contest between content and form in the elementary school is often confused with the contest between the adherents and the opponents to the doctrine of formal discipline. But an emphasis upon the form studies is not inconsistent with the doctrine of specific disciplines. The problem now is to control this emphasis according to the need of these specific forms in the outside environment, to give only such attention to them as will be required for their mastery and for their use in that environment. That a form is often over-

emphasized, we agree, especially as it is sometimes taught apart from the content and relations with which it is environmentally used. But, as Dewey says, form is of as much value as content and should receive its due emphasis "in subordination to an end."

The building of general concepts of method from particular methods is not the work of the elementary school to a great degree. The pupil is not ready for such conceptualizing. The conscious abstracting of the common elements from particular methods and the generalizing of these into a general concept of method require a mental development that rarely comes before adolescence. Therefore, the mastery of particular methods, of special forms, is the methodological aim of the elementary school; and this means, of course, particular methods of the most comparative value in relation to particular subject-matter of the most comparative value. In many subjects and especially in the realm of "morals and manners" there are opportunities for the teacher to suggest other particular applications of a method than those actually applied in particular situations in school or home or playground. These suggested applications extend the consciousness of the method's applicability, and tend to

make widely transferable the specific ability developed through use of the method, even though general concepts are not formed. In the last two years of the elementary school, when many pupils have reached the adolescent period, some specific methods can be worked up into general concepts; but care must be taken not to force this process prematurely.[1] The high-school furnishes the great opportunity in public education for forming general concepts of method, and it is to this aspect of the secondary curriculum that we will devote most attention.

[1] Bagley, *Journal of Educational Psychology*, January, 1910: "The assumption that the elementary school is not important in building general concepts of method has not as yet a satisfactory basis in experimental tests. In the reviewer's opinion, there is a strong probability that the specific training of childhood may be made to issue in general attitudes or prejudices that fulfill the same function as the logically-developed concepts of method." This point is well made. Though we believe that the systematic formation of concepts of method cannot be a part of school work before adolescence, the suggested substitutes for the pre-adolescent period are of great value.

CHAPTER IX

THE SECONDARY CURRICULUM

The most generally valuable elements of the environment having been introduced into the elementary curriculum, there is not as much need for a large body of prescribed elements in the secondary curriculum. The basic representativeness of the elementary course, even more than the age and nature of the adolescent pupils, allows election in the high-school. It must never be forgotten, however, that a general, all-round development of high-school pupils necessitates their mastering such similar elements of subject-matter and of method as will prepare them to meet the general and fundamental needs of the environment they will have in common with each other. Specialization in the high-school should be based upon a minimum of definitely and uniformly prescribed studies, such as English, geometry, United States history, and either biology or physics.

Over and above this limited prescription,

studies with similar elements of subject-matter or of method can be grouped together and elected by pupils according to their individual capacities and careers. The group system can be defended on the principle that similar elements in group studies, rather than exactly the same elements in prescribed studies, are sufficient to promote a similar general development in all pupils, while allowing some freedom of choice. The system can further be defended on the principle that, even though the subject-matter in a group may be different, the similarity of the methods used with this different subject-matter is sufficient and far more important in promoting a similar general development in all pupils. This is especially true if the common elements in the specific methods used by the pupils are consciously abstracted and generalized by them into general concepts of method, applicable to the entire group. If studies have little similarity, either in subject-matter or in method, they should not be grouped together and pupils should not be allowed to substitute one for the other, except as a free elective.

And finally, over and above definite prescriptions and group electives, there ought to be some room in the secondary curriculum for free electives, to allow individuality free play without any con-

sideration of uniformity or similarity as compared with the other pupils.

As to what proportion of the entire course should be given to each of the three divisions—definite prescriptions, group electives, and free electives—few will agree. But, as Dutton and Snedden show, the practical agreement on this problem is really greater than might appear at first thought. "At present it may be said that throughout the secondary schools of the United States there are prescribed: a foreign language, algebra and geometry, English, a science, and one year in history. This makes about two-thirds of the course, leaving certain possible alternations, to be made according as the student aims to enter this or that college, or to go into active life." Of the six prescribed studies, three (algebra, geometry, and English) are definite prescriptions, and three (foreign language, science, and history) are group electives. Of course, in many high-schools the foreign language or science or history is definitely prescribed, but we may consider it the present tendency to put these studies into groups. The authors also emphasize the influence upon this course of the doctrine of formal discipline. "Latin and mathematics occupy prominent places in all secondary school curricula be-

cause of a general belief in their value as agents of mental training. This is illustrated by the fact that in almost all high schools mathematics is a prescribed study for girls as well as boys, although the former will very rarely follow the subject up and apply it to cultural or vocational stages. This theory has also affected the character of the teaching of other subjects not originally introduced for disciplinary purposes. Modern languages, science, and even history have been modified along lines supposed to be suited to mental training." [1]

Although the criticisms made against the haphazard selection of elements in the elementary curriculum apply with equal force to the secondary curriculum, we will not repeat our former discussion, but will confine our attention to the prescribed and the group elective system and to the general method aim of the high-school.

Does the present secondary course, as summarized by Dutton and Snedden, include for the majority of pupils the elements of the most com-

[1] Dutton and Snedden, *Administration of Public Education in the United States,* 1908, pp. 366, 362. A similar discussion is to be found in Brown (J. F.), *American High School,* 1909, Chap. VII. Brown expresses a belief in the specific character of mental discipline but fails to make a consistent application of his belief in his program of studies. See also the outline of definite prescriptions and group electives in De Garmo, *Principles of Secondary Education,* Vol. I., "The Studies," p. 177.

parative value of the environment? As to the specific value of subject-matter or of method, it does not. Algebra and geometry are of comparatively little specific value to most high-school boys and girls, except as a preparation for advanced work in similar subjects, which only a few will take. The need of algebra and geometry in physics has probably been over-elaborated, and the need of them in some vocations is a special (elective) not a general need. The subject-matter of English is, of course, of supreme value in giving an acquaintance with the best uses of our language and the best ideals of our literature, though there is a doubt as to the environmental value of some of the linguistic and literary anatomy now required. The three group electives (foreign language, science, and history) vary in specific value according to the subject taken in each of the three groups. Some studies in a group may rank above others in that group in the community of their elements with more frequent and more important elements in the environment of most pupils. Therefore, a pupil may elect from a group a study of less value, and this loss in his general development may not be compensated for by advantages to his individual capacity or career, because in the same group a more valuable

study for general development might also have had just as much value for him individually. As has been suggested, the group system is justified by its efforts to combine general representativeness with individual freedom, but many efforts of this kind fail by sacrificing the former to the latter without compensation. It might be wise to increase the number of definite prescriptions and still leave a surplus for group election. However, for both the definite prescriptions and for the group electives in the secondary curriculum, there is great need for a more careful study of the specific values of subjects than has yet been attempted.

In the secondary school, far more than in the elementary school, studies have a general method value in addition to the value of their specific subject-matter and method. The rationalizing tendency of adolescent pupils can be guided to form, from the specific methods used, general concepts of method of great environmental value. But we repeat that concentrated effort on the part of both teacher and pupil is required to do this. The most wasteful weakness in high-school teaching is the failure to work out and apply general concepts of method—from mathematics, concepts of an exact and universally valid method; from natu-

ral sciences, concepts of the inductive and deductive phases of scientific method; from languages, concepts of how to interpret and master forms of expression; from history, concepts of how to understand and deal with social conditions.

What are the kinds of general method to be prescribed, definitely or by groups, in the curriculum of all high-school pupils? First, the method of pure mathematics; second, the method of the mathematico-physical sciences; third, the method of the biological sciences; fourth, the method of the psychological sciences; fifth, the method of the sociological sciences. The first method is exact and universally valid—the ideal of all the sciences; the second approaches the first in so far as our knowledge of the data and their causes allows us to use exact quantitative forms; the third includes life variations, and, therefore, connot use exact quantitative forms; the fourth includes the psychic in addition to the life variations; and the fifth includes the social in addition to the life and the psychic variations. There is a decrease in exactness and validity as we go from the first to the fifth. Every high-school pupil should know and use each of these five divisions of method, for one method cannot take the place of another and even within these

large divisions there are subdivisions with important differences in method. In the secondary curriculum, geometry is a good example of the first method, physics of the second, botany of the third, psychology of the fourth, and history of the fifth. Physical geography uses mainly the second and the third methods; language, literature, ethics, and art the fourth and fifth. At present, the secondary curriculum is weakest in the fifth method,—the most important of the five. It should be specially represented by history, civics, economics, and commercial geography. In addition to these five divisions of method, emphasis should be given to the methods of manual, domestic, and industrial training. If all high-school pupils are required to work out and apply each one of the methods here mentioned, they ought to be well educated, especially if the methods have been derived from studies of great specific value.

Our brief mention of elementary and secondary curricula serves only to illustrate the standard of values previously outlined. We have confined our discussion and our references almost entirely to the one problem of mental discipline, with a few of its applications. Though we have purposely omitted any discussion of college education, on account of our skepticism regarding it, we be-

lieve that the principles emphasized in this essay will apply to it also.

Mental discipline is the most important thing in education, but it is specific, not general. The ability developed by means of one subject can be transferred to another subject only in so far as the latter has elements in common with the former. Abilities should be developed in school only by means of those elements of subject-matter and of method that are common to the most valuable phases of the outside environment. In the high-school there should also be an effort to work out general concepts of method from the specific methods used. Through courses which develop valuable specific abilities and, in addition, valuable concepts of method, the school can become a vital, direct means of preparing boys and girls for environmental usefulness, especially if the school combines, simultaneously or successively, with the general course such vocational training as will make its graduates independent economic factors in society.

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